WIRE & WIRE PRODUCTS

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

WIRE DRAWING EQUIPMENT

Morgan-Connor continuous machines

Morgan-Paff wire blocks

Rod frames

Wire mill accessories

MORGAN CONSTRUCTION COMPANY
Worcester, Mass.

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October 1933

Are You Interested in Obtaining *Continuous* Production of 1,000,000 BOLTS *Or More*, Per Die Size?

Carboloy extrusion dies usually average not less than 1,000,000 bolts in any size up to ⅜″. And production of 2,000,000 and over is not uncommon. For sizes over ⅜″, profitable quantities are also being obtained.

Other advantages of Carboloy cemented carbide for bolt and rod extruding work include closer tolerances on pitch diameter of rolled thread, longer life for thread rolling dies, and less down time on machine.

These cost saving possibilities of Carboloy cemented carbide on bolt and rod extruding work are worth investigating. Send for full details without obligation.

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National Metal Exposition
Convention Hall, Detroit
Oct. 2-6, 1933

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REG. U.S. PAT. OFF.

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For all types of high and low carbon steel, drill rod, brass, Bronze, copper, aluminum, zinc, monel metal, iron, nickel, gold, silver, etc.

EXTRUDING DIES

Dies for extruding all materials on which threads are to be rolled.

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For sizing nuts, bullets, bushings, etc.

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Shaped dies (one piece or sectional) for drawing special shapes on bar and wire stock.

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For all steps in the drawing of ferrules, eyelets, split rivets, etc.

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Spring coiling pitch tools, mandrels and guides. Coiling guides for armored wire, hose, cable or rope.

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Carboloy service includes assistance to all customers in equipping their die rooms for finishing, servicing and recutting cemented carbide dies. Our Service Department is prepared to recommend or furnish the latest, most efficient equipment for this work. Trained operators are available to instruct your die room personnel in correct methods for Carboloy dies.

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THEY *are* FUNDAMENTAL
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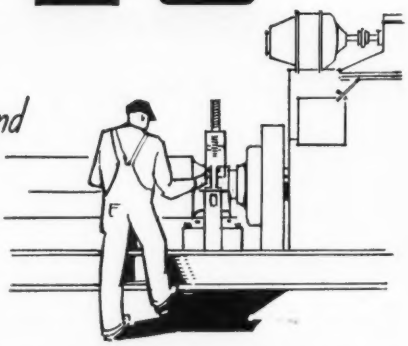
PROFITABLE OPERATION
DEPENDS LARGELY ON *their*
PERFORMANCE



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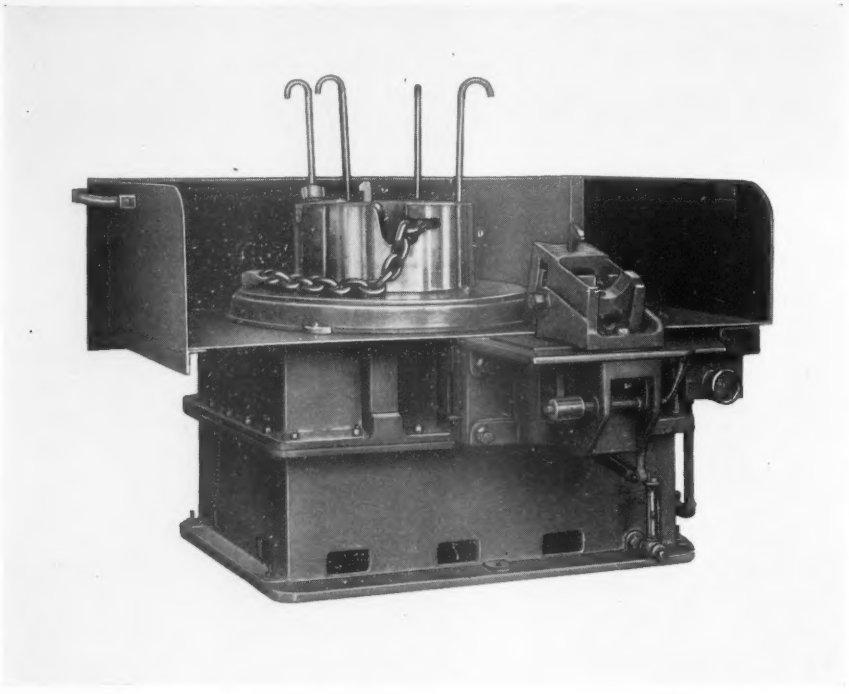

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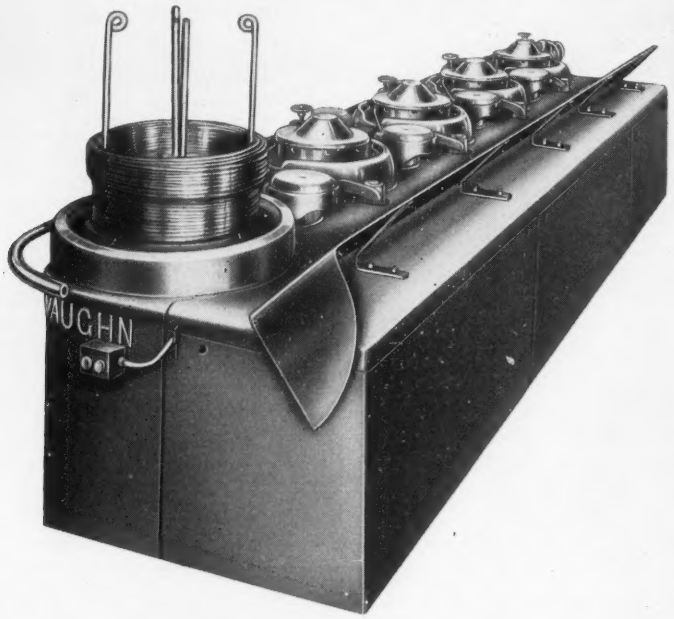

5-Draft Rod Machine

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A CONTINUOUS wire drawing machine, the logical development of the Motobloc principle to meet conditions where continuous operation is dictated . . . Any number of dies for both rod and intermediate sizes.

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Cinder Grinders.

Cut Double Helical Gears and Mill Pinions.

Gear Drives.

Flexible Couplings.

Blast Gates.

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Farrel-Birmingham Copper Rod Mills are designed to roll a diversified product of high quality at low cost. Low productive cost means high speed operation with a small operating force, low power consumption and minimum scrap. Automatic handling equipment reduces labor; maximum power saving is obtained by anti-friction bearings throughout; and high quality with minimum scrap is assured by proper design.

Fig. 1—20″x60″ three-high breaking-down and roughing stands of copper rod mill, showing feed table and oval repeater.

Farrel-Birmingham engineers will design, supply and install complete copper rod mills from furnace to coilers for any required output. Full details about the benefits derived from the installation of modern, low cost Farrel-Birmingham equipment will be sent upon request.

Figures 1 to 4 inclusive are views of a complete eleven-stand mill with a capacity of 150 tons of ¼″ round copper rod per ten-hour day, or 200 tons of $\frac{5}{16}$″ and ⅜″ rods. The mill consists of a 20″x60″ three-high breaking-down stand, a 20″x60″ three-high roughing stand and an intermediate and finishing train of nine strands with rolls of 20″ face graded from 11½″ to 14″ in diameter.

Fig. 2—Intermediate and finishing train of copper rod mill. Note repeaters and tubes to coilers.

All of the mills are equipped with anti-friction bearings on the rolls and pinion units, greatly reducing friction and power consumption. Farrel-Sykes cut double helical, continuous tooth mill pinions, with universal joints connecting the rolls and pinions, transmit power to the rolls smoothly, silently, efficiently.

The breaking-down and roughing mills are completely equipped with feeding tables, stop gate, turning guides and repeaters, placing complete control of all passes and operations, from the loading of the heating furnace to the first pass in the finishing train, in the hands of one operator stationed in the pulpit. Automatic looping repeaters are also provided for two passes in the intermediate train. The automatic feeding features make it possible to operate the complete mill at increased capacity with a considerable saving in labor.

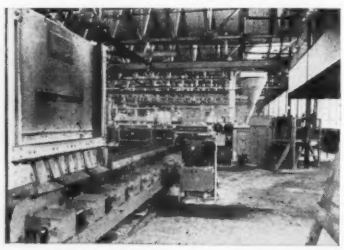

Fig. 3—Roller feed table from furnace to breaking-down mill. Control pulpit is shown at right center.

From the last mill the finished rod is delivered through tubes to the coilers. Three coilers are provided and the delivery tubes are so arranged that any grooves which may be set up in the mill can deliver to any one of the three coilers. The coilers are designed to coil hot copper rod up to ½″ diameter at delivery speeds up to 1600 fet per minute.

The coilers and the conveyor, onto which the coilers discharge, are controlled at a desk located in front of the coilers. The operator at this desk controls the starting and stopping of the coilers and of the conveyor, and the alignment of any particular groove in the finishing mill with any particular coiler.

Fig. 4—Three copper rod coilers with conveyor to cooling tank. Control desk is shown at the left.

HEAVY DUTY ROLL GRINDERS:

Farrel Heavy Duty Roll Grinders are widely used in metal rolling plants for grinding all types of metal working rolls. They are designed for better, faster and cheaper grinding to the extreme limits of accuracy required by modern industry.

They are made in six standard sizes to handle rolls up to maximum diameters of 26″, 32″, 36″, 44″, 52″ and 60″, and in any lengths from 8′0″ to 26′0″ between centers. Figure 5 is a general front view of a 60″x20′0″ machine.

Design features:. Individual motor drive for each unit with centralized control at operator's station. Crowning device produces mathematically correct crown or concavity — very easily and quickly set. Improved spindle and wheel head design. Carriage driven by reversing motor through cut double helical gears and worm and rack. Inverted V-type ways, flood lubricated. Dead centers in both headstock and footstock. Heavy, rugged construction imparts stability. Combination of all features assures high quality of work with maximum production.

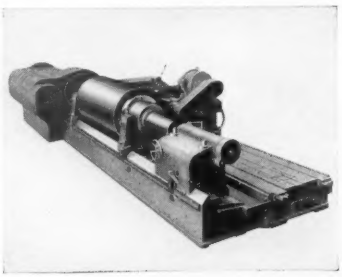

Fig. 5—60″x20′0″ Farrel heavy duty roll grinder.

FARREL-SYKES GEARS AND GEAR UNITS:

Spur, helical and herringbone gears of any material suitable for gears:. ¼″ to 20′0″ in diameter; ¼″ to 54″ face; 24 D.P. to ¾ D.P. Produced by gear specialists — accurately generated — smoothly finished. Efficient, quiet, durable.

Herringbone Gear Units in single, double and triple reductions. Any ratio from 1/1 to 300/1. Any horsepower from 1 to 10,000. Meet all requirements for uniform, silent and positive transmission of power.

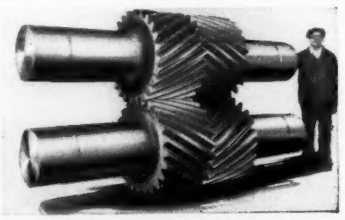

Fig. 6—Farrel-Sykes continuous tooth herringbone mill pinions.

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RIGHT IN LINE

There will be discussion galore at the Convention on wire drawing costs. The Continuous and Single Hole methods will both find advocates.

Just to start the ball rolling we submit three sets of figures which definitely bring out the real savings effected by our Double Draft Continuous machines.

These figures, which deal only with high-carbon wire, are up-to-the-minute and were supplied by a busy mill on Sept. 18, 1933. They are straight labor costs and do not include over-head. Obviously the Continuous machine also gives big savings in power, floor space and general efficiency.

EXAMPLE NO. 1

Dry Drawing Patented .60 Carbon Wire Through Five Holes from No. 13½ to No. 20 Gauge.

On Continuous Machines cost was 32c per 100 pounds.
On Single Hole Machine cost was 44c per 100 pounds.

Increased cost of Single Hole work was 37%

EXAMPLE NO. 2

Dry Drawing Patented .60 Carbon Wire Through Five Holes from No. 20 to No. 25 Gauge.

On Continuous Machines cost was 61c per 100 pounds.
On Single Hole Machine cost was 80c per 100 pounds.

Increased cost of Single Hole work was 30%

EXAMPLE NO. 3

In drawing the finer sizes of high-carbon wire on Eight-Draft Continuous machines under liquor the direct-labor cost is from **30 to 50% less** than the same work on single hole machines.

SLEEPER & HARTLEY, INC.

WORCESTER, MASS., U. S. A.

BUILDERS OF THE MACHINES THAT PUT THE 'RINGS' IN SPRINGS

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Wire Association

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Nepowder 100 is the most remarkable inhibitor in powdered form which has even been developed. The only powdered inhibitor 100% pure containing no dope or loading material. You are paying $1 a pound for the inhibitive content of present powders.

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Nepowder 100 is 100% pure; completely soluble in cold sulphuric and muriatic acid. One pound of Nepowder 100 will control or inhibit 2,000 pounds sulphuric acid. Two gal of 66° H_4SO_2 will dissolve one pound of Nepowder 100% pure. These two gallons in your reserve tank will inhibit 2,000 pounds of acid.

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NEP NO. 1 LIQUID, A STRONG INHIBITOR, GOOD FOAM PRODUCER, SOLUBLE IN SULPHURIC ACID. CAN BE PLACED DIRECTLY IN YOUR ACID TANK. WILL NOT SETTLE. SOLUTION HOMOGENEOUS. THE MOST EXTENSIVELY USED LIQUID INHIBITOR ON THE MARKET TO-DAY IN THE WIRE INDUSTRY.

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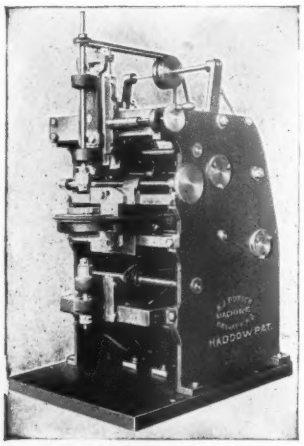

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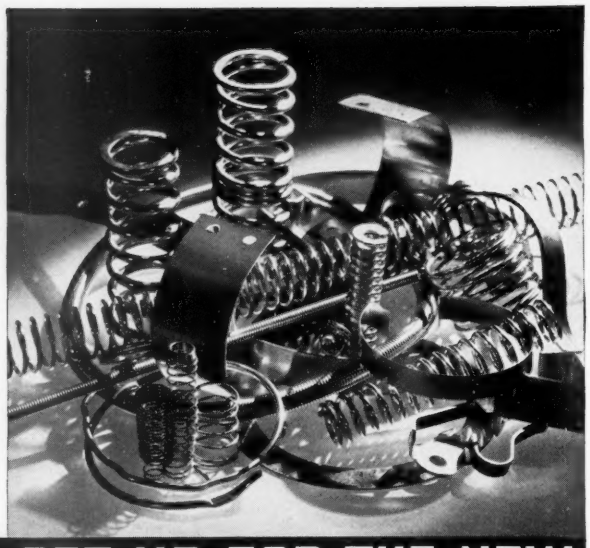

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A monthly publication devoted to the production of Wire, Rod and Strip. Wire Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING.

Vol. 8 October 1933 No. 10

Designated as

Official Publication By The Wire Association

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17 E. 42nd St., New York City. Telephone: Murray Hill 2-4188

Publication Office: Washington, N. J.
Annual Subscription, U. S. $5.00, Canada $5.60
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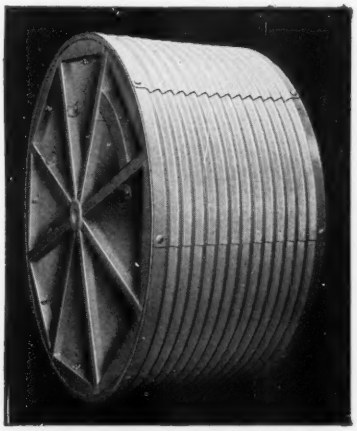

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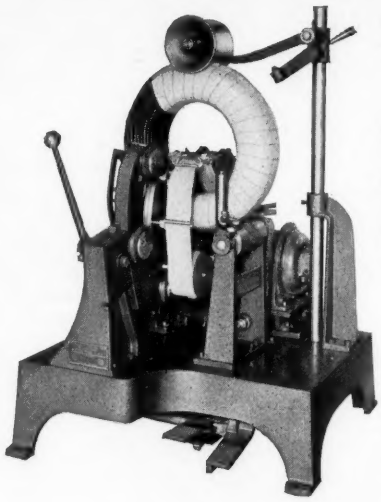

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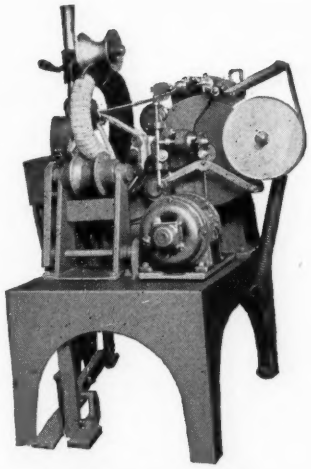

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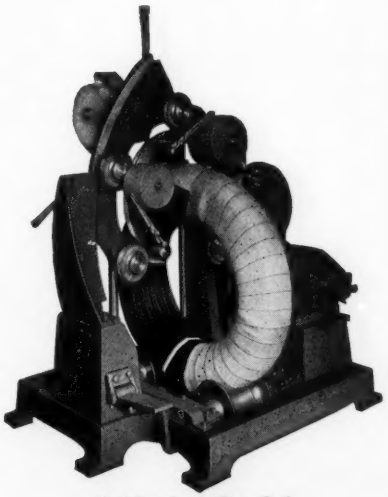

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Vol. 8 October 1933 No. 10

Sizing and Resizing Carbide and Diamond Dies For Copper Wire Drawing

J. J. Kehoe, Designing Engineer, Wire Department
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The General Electric Company, Schenectady, N. Y.

A description of the Processes and Methods used by the General Electric Co., Schenectady, N.Y. A paper prepared for The Wire Association.

THE demand in recent years for improved quality of finish on copper wire and for more uniform physical characteristics has made necessary a very close control of rod quality—drawing compounds—and die shapes and finishes. This article is a description of methods which, to date, we have found most satisfactory for the finishing and polishing of our dies.

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OUR experience indicates that good results are obtained using tungsten carbide dies for the larger sizes and diamond dies for the finer sizes of wire.

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FOR convenience we shall first discuss the tungsten carbide dies.

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Tungsten Carbide Dies

FIGURE 1, a straight line diagram of a cross section of a die nib, defines its parts: i. e., opening, approach, bearing, and relief.

✦ ✦ ✦

EXPERIENCE has established the following empirical rules for dimensions:—

Depth of relief—.030".
Bearing length—0.5 x diameter of bearing.
Approach length—1.1" x diameter of bearing.

Depth of opening is equal to the total height of the nib less the sum of the above three dimensions and must be no less than 0.300".

✦ ✦ ✦

FOR economy several different sizes of nibs are used, each size being used for a range of sizes of wire. Nib dimensions are determined as follows:—

Height=0.330"+1.6 x diameter of maximum size wire drawn on this nib.

Diameter of nib must be no less than height of nib.

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THE rough nib is made with an opening angle of 28°, an approach angle of 15°, no bearing, a relief angle of 45°, relief depth of no more than 0.030", and with a minimum diameter of approach (rough finished hole) as determined from Figure 2 for the size for which the nib is to be first used.

✦ ✦ ✦

THE nib is mounted in a rough casing and is then finished and polished as outlined in the following operations:—

Finishing and Polishing New Dies

First Operation

REFERRING to the drilling machine shown in Figure 3, the die is placed in a metal "basket" (1) which is filled just sufficiently to cover the die with No. 400 carborundum powder mixed with machine oil to a wet-paste consistency. The basket is placed on the revolving plate (2) so that the hole in the die is under a pointed drill, a tapered cold rolled steel pin having a 16° included angle. It is then lapped to the semi-finished hole size at bearing end determined from Figure 2.

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Second Operation

THE die is then faced and turned down to size in a bench

lathe (Figure 3). The back of the casing must be maintained perpendicularly to the axis of the hole in the nib.

✦ ✦ ✦

Third Operation

THE die is then set up exactly as in the first operation, except that a 30° included angle taper pin is used, and is lapped to the depth of opening as determined from Figure 4.

✦ ✦ ✦

Fourth Operation

LEAVING the die in the same machine, and using a straight pin, the bearing is lapped to 0.005″ under the finished size required for sizes 0.100″ and smaller and 0.007″ under for larger sizes. Pins 0.227″ and smaller in diameter are made of stub steel and larger sizes of cold rolled steel.

✦ ✦ ✦

BEARING diameters 0.100″ and smaller are generally lapped using only one size of pin. Larger diameters, due to the greater difference between the rough hole size and the finished diameter required, must be lapped successively with two or three sizes of pins in steps of no more than 0.015″.

✦ ✦ ✦

Fifth Operation

THE die is next mounted in a bench lathe (Figure 3) in a draw collar and the sharp edges at the relief are slightly rounded off, to avoid excessive wear of the steel braid (5, Figure 3) of the string polisher, using a steel pin having 90° taper and using diamond dust as an abrasive.

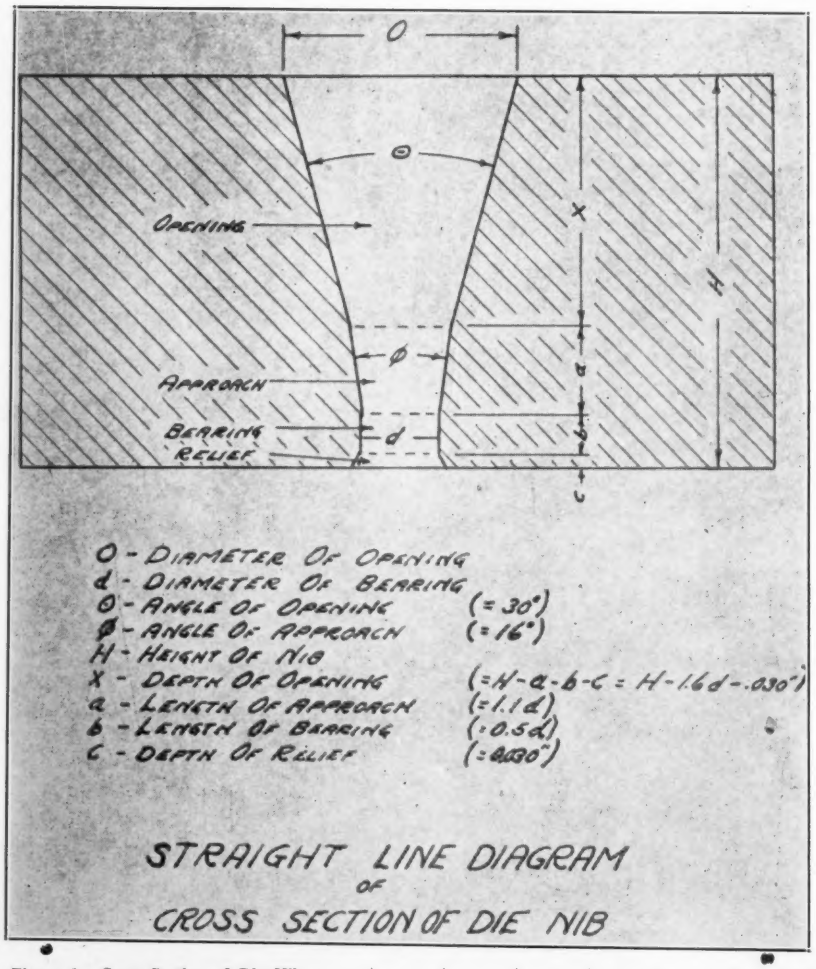

Figure 1. Cross Section of Die Nib.

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Sixth Operation

THE die is then placed in a string polisher (Figure 3) and with a steel braid (5, Figure 3) in contact with the bearing only and using reclaimed diamond powder as abrasize, the bearing diameter is increased about 0.002″. The steel braid is then dropped by means of pulleys (3 and 4, Figure 3) so that it is in contact with opening, approach, bearing, and relief and the diameter of the bearing is increased until it is 0.002″ under the finished size. In this operation, all sharp corners are removed.

✦ ✦ ✦

Seventh Operation

THE die is now placed in a jeweler's lathe and, with a dowel pin and reclaimed diamond powder, it is polished to the finished size.

✦ ✦ ✦

Eighth Operation

THE die is inspected for smoothness, size, and polish; it is stamped with serial number and size; and is placed in stock.

✦ ✦ ✦

Resizing Worn Dies

WORN dies to be resized for use as break down dies or not to be used as finishing dies are completely finished on the string polisher which gives sufficiently high polish and accuracy for break down dies.

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WORN dies to be resized for finishing dies, are similarly handled except that bearing diameter is brought to 0.002″ smaller than the finished size. The die is then polished to finished size as in the Seventh Operation above.

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ALL resized dies are inspected, stamped with the new size, and put in stock.

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IN the above, reclaimed diamond powder is used on the steel braid as an abrasive.

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IN both cases the steel braid is brought into contact with the surface to be resized by adjusting

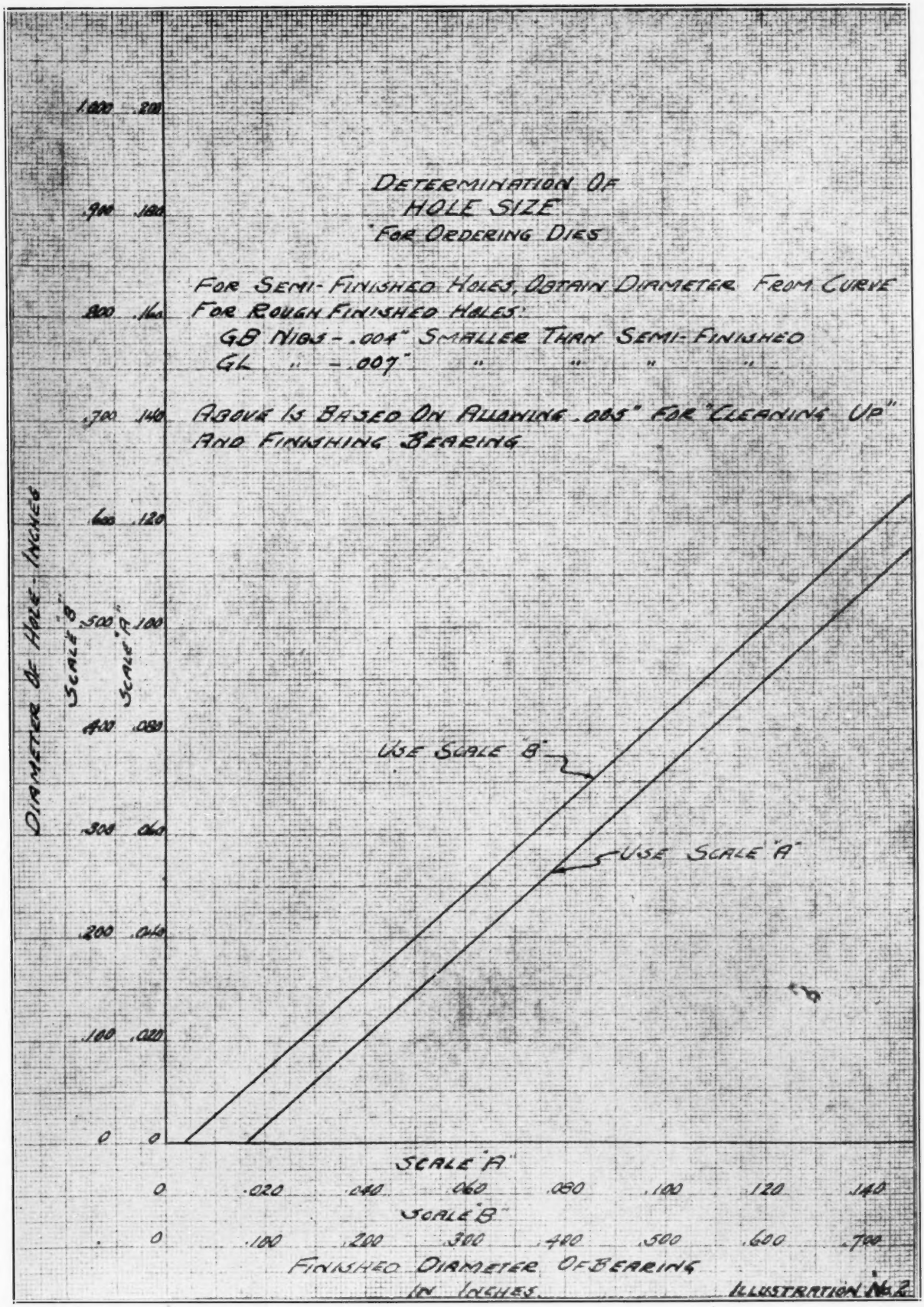

Figure 2. Determination of Hole Size.

the pulleys (3 and 4, Figure 3). To adjust pulley 4 for the proper angle of opening or approach, as may be desired, a special attachment (6, Figure 3) is used. This attachment consists of an arm and a graduated scale mounted concentrically with, but not on, the pulley. The arm has a straight edge which, if extended, would be tangent to the bottom of the groove of the pulley irrespective of the rotation of the arm about its center. To adjust the pulley for a given angle of the steel braid, the arm is turned so that it reads that angle on the scale. The pulley is next raised or lowered until the steel braid is parallel with the straight edge. The pulley is then clamped in position and the attachment is dropped out of the way.

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General

WHEN the dies are given out, the operator is given a card listing the sizes and serial numbers of the dies issued to him. When they are returned to the stock-room they are checked against this card. They are then washed and carefully examined for size and wear. All dies which are found to be still satisfactory for further use on the same size are placed in the stock rack where they are segregated as breakdown or finishing dies. Unsatisfactory dies are tagged with a notation as to the work to be performed on them and are put in separate stock for repair.

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Diamond Dies

New Dies

IN the case of diamond dies, we resize only; all new dies are purchased finished. As the quality of diamond is of prime importance in determining the service of a die, great care must be exercised by the die manufacturer in the selection of stones for our dies as we have established standards based on the poundage of wire produced per die for the total life of the die.

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IT is imperative in selecting diamonds that only stones free from seams, carbon spots, and soft spots, of close grain structure, of regular shape, and of sufficient wall stock be used. For sizes 0.0253″ and smaller, there must be sufficient stock to permit resizing to double the original size, and on larger sizes to 50% greater than the original size. This difference is due to the fact that we rarely use diamonds in sizes larger than 0.0641″.

✦ ✦ ✦

IN the setting it is extremely important that the diamond be rigidly supported at all points around the circumference to prevent cracking of the diamond under the high pressures developed in wire drawing.

WHEN mounting in the casing, the axis of the hole in the die must be perpendicular to the back face of the case.

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ALL new dies are inspected for seams, carbon spots, shape, polish, and size. Dies here found unsatisfactory are rejected. Satisfactory dies are then given a running test on a wire drawing machine. If wire draws oversize or out of round, the die is rejected. If wire is slightly undersized but not out of round, the die is repaired in our own die room.

✦ ✦ ✦

Resizing

IN resizing worn dies, the work is done on a Haddow machine. In this machine the die is mounted in a rotating chuck with axis of the die hole vertical. A steel wire, passing through the hole in the die, is fastened at each end to an arm. These arms impart a reciprocating motion to the wire. The wire is maintained taut under spring tension. Several grades of diamond dust are used on this wire as abrasive for cutting and polishing.

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RESIZING is done in steps of standard A.W.G. numbers. For sizes 0.253″ and smaller, the steel wire used is the size to which the hole is being increased. The

(*Please turn to page 330*)

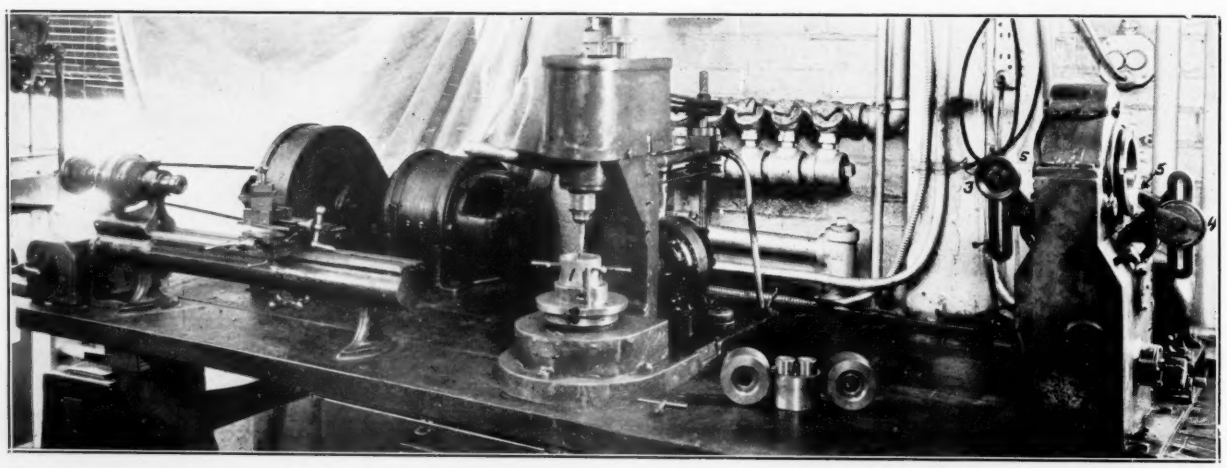

Figure 3. Bench Lathe. ✦ ✦ ✦ ✦ Drilling Machine ✦ ✦ ✦ ✦ String Polisher. ✦ ✦ ✦ ✦

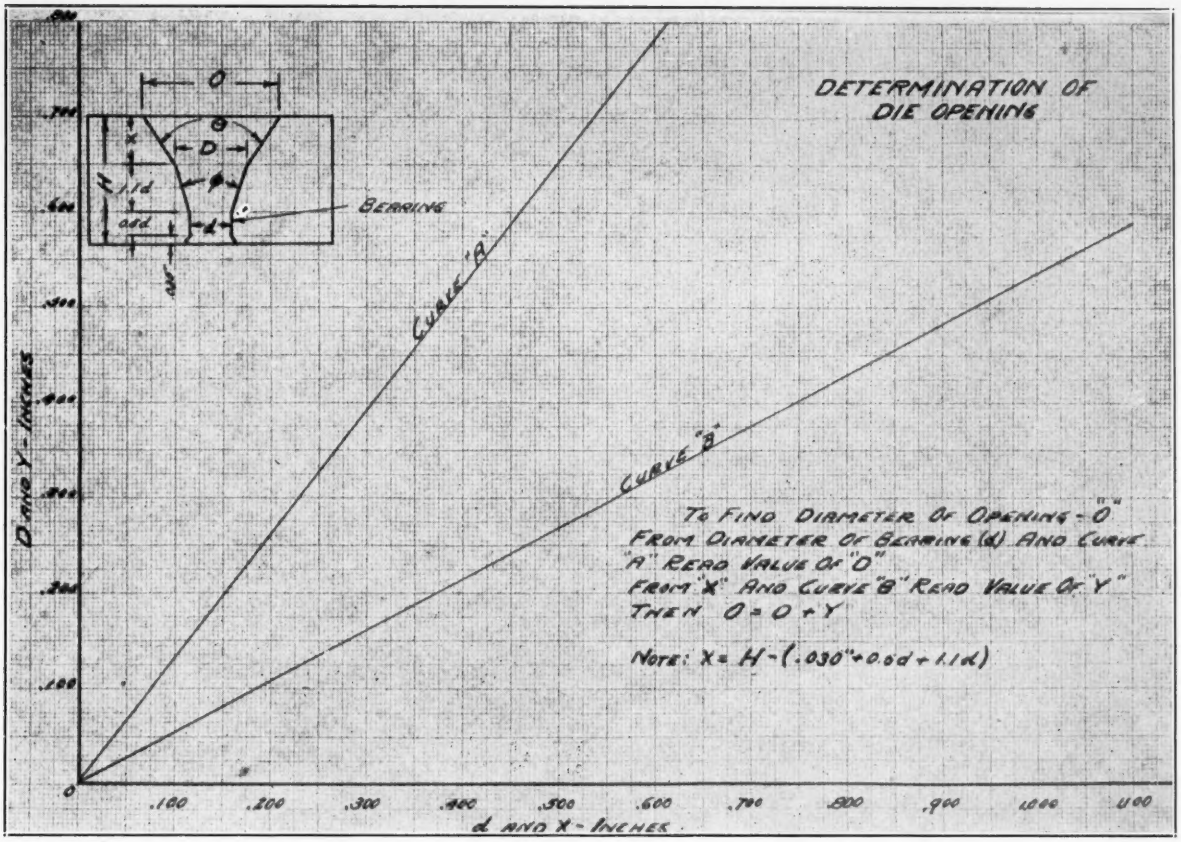

Figure 4. Determination of Die Opening.

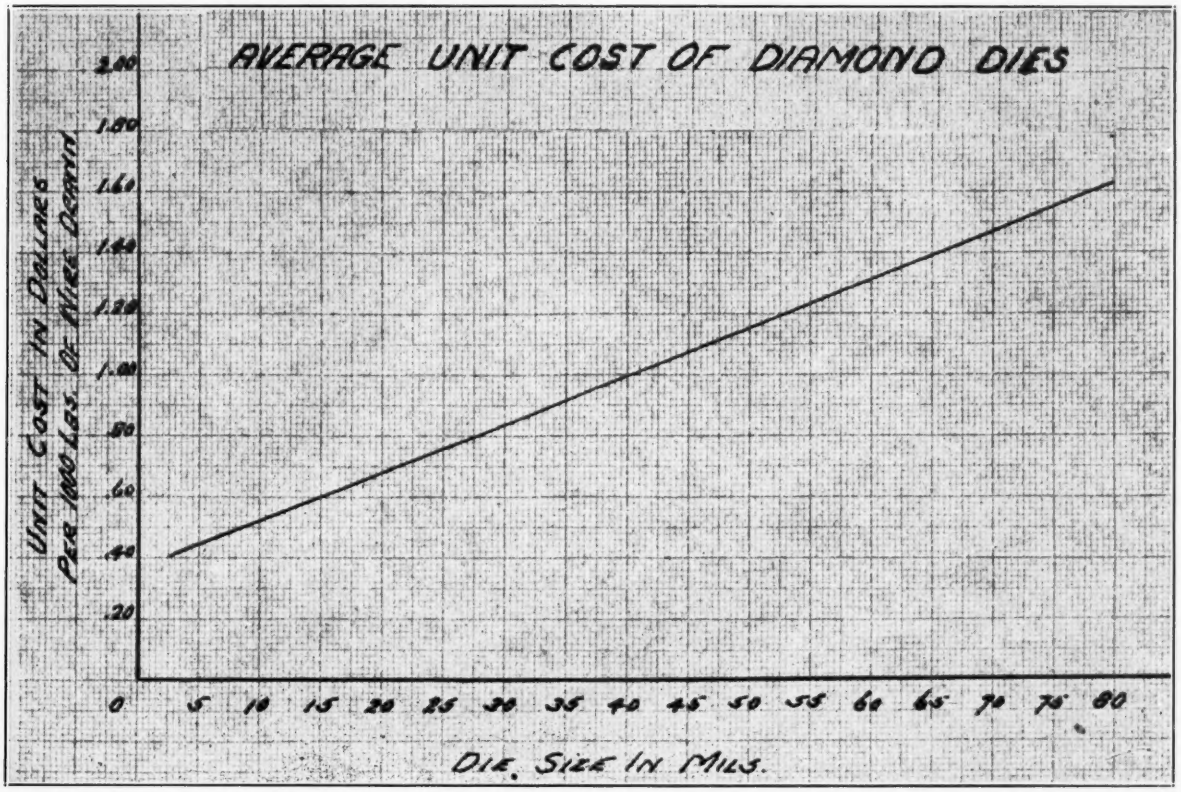

Figure 5. Average Unit Cost of Diamond Dies.

Copper Alloy Wire

By James T. Kemp,
Service Engineer, American Brass Co., Waterbury, Conn.

A paper for the Wire Association outlining the development and principal uses of copper alloy wire. ▼ ▼ ▼ ▼

THE present is often spoken of as the Era of Alloys, and with good reason. Man's progress from the simplicity of rural life can be measured in terms of the metals he has used. Certainly there is a close relation between the almost magical economic development of the past half century and the steadily widened use of metals that has resulted from compounding them with one another. The alloys of iron have perhaps been most spectacular, but they are no more fundamental to the present day needs of them than the less widely heralded alloys of the other metals. In the whole list of metals none are more essential than copper and the alloys based upon it. Copper spans the ages. On one hand the most ancient of the known metals is copper, on the other, the newest to be put to daily use is the alloy of copper, with beryllium. Between these, in point of time lie a large number of others of greater or less importance.

✦ ✦ ✦

THERE are many commercial metals and combinations of metals not based on iron or copper, which possess the ductility necessary for drawing into wire. Each is important in its place, but together they do not rank in poundage or variety of uses with the family headed by copper. Among them should be mentioned the following metals and the alloys in which they are the principal element:—aluminum, nickel, zinc, tungsten, and combinations of one or another with iron, chromium, copper, manganese, etc.

✦ ✦ ✦

THERE are many copper alloys which are manufactured into wire. In number and refinement they are multiplying steadily. They may be roughly divided into three groups, according to the usage made of them.

1—Conductors of electricity
2—Materials of construction
3—Other uses for which wire is a convenient form for handling.

The manufacturers of wire may classify the alloys in another way, based on the method of first reduction from cast wire bar or billet.

1—Those rolled to rods hot
2—Those rolled to rods cold

Some wires, especially those of the low copper contents, may be reduced initially by extrusion. The alloys which are manufactured into rod by the latter method fall almost entirely into group 3 of the first classification, metals which do not necessarily remain in wire form in final use.

JAMES T. KEMP
Service Engineer
American Brass Company.

✦ ✦ ✦

MANUFACTURING practice, other than rod rolling, is very much the same with all these alloys. The initial drafts are performed on heavy machines, one reduction at a time. Later reductions and finer sizes are produced on multiple die machines. They must all be annealed from time to time in the course of drawing to fine sizes, and can be finished in a variety of tempers ranging from dead soft through light annealed and light to hard tempers. Naturally some of the metals are more ductile and can be drawn further between anneals than others. The manufacturer, therefore, adapts his mill practice to his metal. Figure 1 graphically represents the tensile strength of four common alloys and copper and the relation of tensile strength to reduction in drawing. The behavior of these few alloys is representative.

✦ ✦ ✦

IN the first group, wires which are used for electrical purposes, electrolytic copper finds the widest use of any of our present day materials. There is, nevertheless, a growing demand for wire of good conductivity and higher physical strength than copper possesses, for line construction material. Less important lines or branches such

THE writer wishes to acknowledge the courtesy and assistance which has been shown him by his associates, and particularly he expresses gratitude to Mr. W. H. Bassett, Metallurgical Manager, Mr. H. A. Bedworth, Supt. of Service Engineering and Mr. R. E. Marshall, all of The American Brass Company and Mr. W. H. Bassett, Jr., Technical Supt., Anaconda Wire & Cable Co.

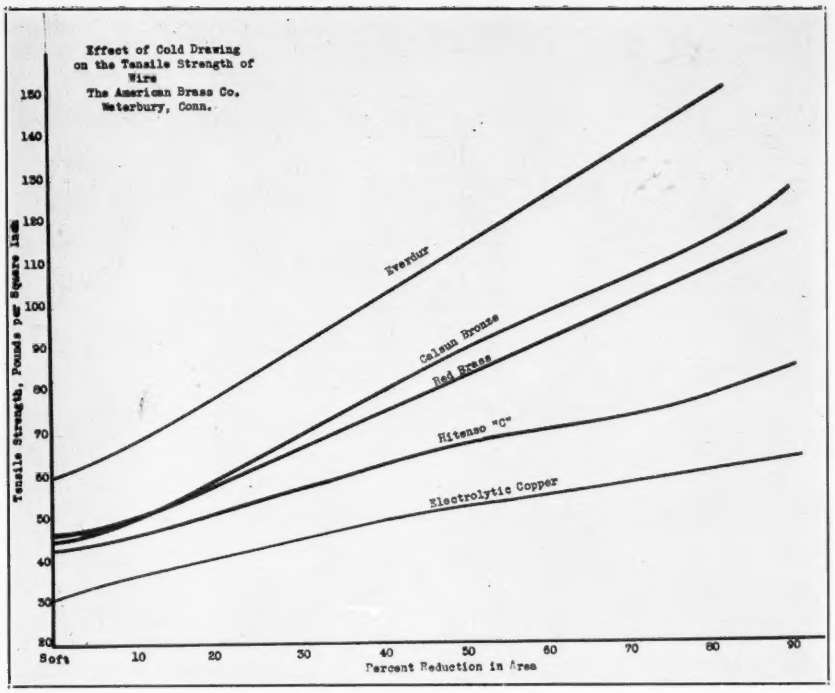

Figure 1.

as those used for rural distribution, can be built of high strength alloy wire to good advantage, balancing the extra cost of the alloy against the savings in poles, insulators, etc., resulting from the longer spans possible. Cadmium copper is being used for these purposes in sizes around No. 10 B & S. Cadmium copper, popularly known as "Hitenso", has been used in the greatest quantity, however, as trolley contact wire where its strength and hardness combine to give it long life and resistance to wear, to overloading and sparking. Cadmium alloy wire is manufactured in three grades having electrical conductivities approximately 85%, 80% and 55% of copper, measured against the International Annealed Copper Standard. The tensile properties vary inversely as the conductivity, the lower conductivity wires possessing the highest strengths. All the Cadmium copper wires are supplied hard drawn for the uses named.

TABLE I

Comparison of Copper and Alloy Wires
No. 10 B & S Gauge
Minimum Specification Values

	Composition Balance Copper %	Tensile Strength Lbs. per sq. in.	Conductivity % of soft Copper
Copper, Soft, A. S. T. M.		37,000	98
Copper, Medium Hard, A. S. T. M.		50,000	97.5
Copper, Hard Drawn, A. S. T. M.		64,300	96
Cadmium Copper, Hitenso A	0.8 Cadmium	79,200	85
Cadmium Copper, Hitenso BB	1.0 Cadmium	93,400	80
Cadmium Copper, Hitenso C	0.8 Cadmium 0.5 Tin	90,000	55
Medium Strength Bronze	0.5 Tin	74,300	65
High Strength Bronge	1.2 Tin	84,000	40
Tin Bronze, Signal Bronze	1.8 Tin	100,100	31
Silicon Bronze	2.0 Tin 0.75 Silicon	123,000	12
Red Brass	20. Zinc	127,000	25
Calsun Bronze	2.5 Aluminum 0.75 Silicon	123,900	12
Everdur	3.0 Silicon 1.0 Mang.	141,800	5

COPPER alloys having conductivities below 50% are widely used for special purposes. "Drop wire" used by the telephone companies, is commonly a hard drawn tin bronze of high strength, but possessing an electrical conductivity of the order of 35% of copper only. This bronze contains about 1.75% tin. Other tin bronzes, generally of lower tin contents, are used to some extent for line wire. The resistance and physical strengths of the bronzes vary directly with the tin contents. The tin bronze group includes many alloys made to definite and narrow ohmic resistance requirements for motor windings and other electrical apparatus. The bronzes lie in a borderland in which electrical properties are important to some consumers, and mechanical properties to others. The tin bronze just mentioned in connection with "drop wire" may be used also for springs or twisted into strand.

AS the amount or number of alloying elements is increased, the conductivity of the resulting metal is lowered, and we pass from the field of essentially electrical use into that which is essentially mechanical. For mechanical purposes, wire should possess strength, fatigue endurance and resilience. The copper group of alloys add to these properties a marked degree of corrosion resistance.

THERE is, of course, another group of wire alloys valuable for their very low conductivity, but used for carrying electrical currents, namely resistance and heater wires Such wires have high resistances, 125 ohms per mil foot and more They do not oxidize rapidly at elevated temperatures, and possess fair tensile strengths at such temperatures. In this group are to be found Cupro Nickel and several nickel silvers. Commercially, however, the alloys of neckel with iron, chromium and

other elements, have assumed greater importance than those of copper, largely because of their higher resistances and very high melting points.

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WIRES for mechanical purposes embrace a larger number of the alloys of copper than those used for strictly electrical purposes. Without exception, those elements that impart strength to copper alloys also depress its conductivities to levels which are uneconomical for general transmission purposes. The intensity of the effect of an alloying addition is in general proportional to the amount introduced.

✦ ✦ ✦

THE oldest mechanical wires of commercial importance are, without doubt, the brasses, alloys of copper with zinc. The brasses are all ductile and readily manufactured into wire. Their useful field today is in the production of articles where duties are light and corrosion exposure mild. Formerly the low zinc brasses, up to 15% or 20%, were used for cables, guy strand and similar outdoor uses, but they have been displaced by other alloys of equal or superior strength and of better corrosion resistance The high zinc brasses meet the needs of the lower priced markets. In many cases the choice of a brass will be determined by its color. A homely but very familiar article of yellow or high brass, is the common bird cage, the spring and the chain it hangs on. Jewelry manufacture absorbs large poundages of brass wire. So does the paper industry, in the form of fourdrinier screens and the makers of brake lining for reinforcing their woven linings.

✦ ✦ ✦

THE effect of progressive additions of an alloying element to copper can be shown very nicely in the case of the brasses. The effects of adding other elements such as tin, aluminum, silicon, etc., to copper, are similar, but the range of useful additions in their cases is much more limited and therefore the effects of progressive additions less easily illustrated. Metallurgically, the alloys of copper possessing sufficient ductility, to be used

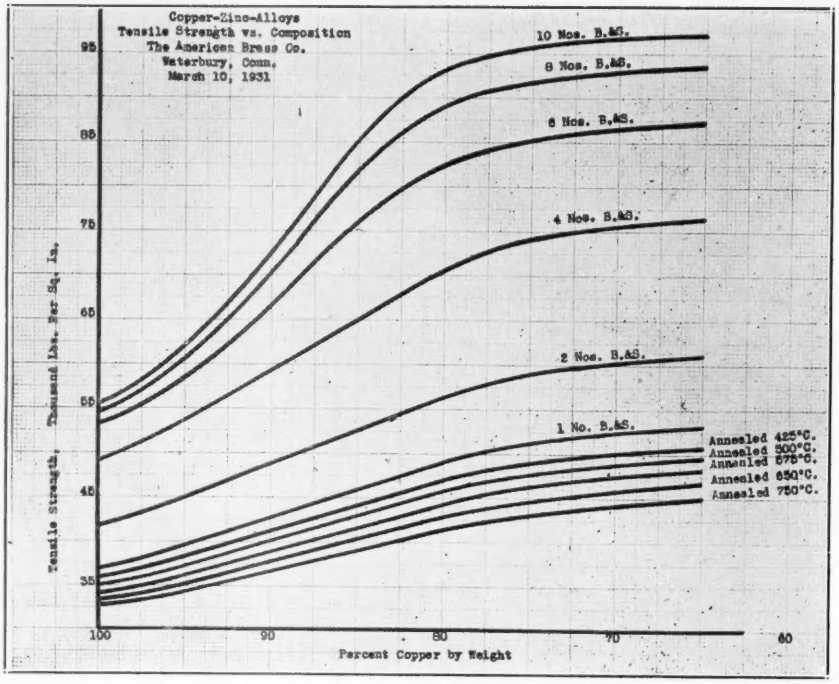

Figure 2.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

as wire are alike in being unsaturated solid solutions or if saturated solid solutions with a small proportion only of the second solid phase. The saturation limit of zinc in copper lies at 39% zinc at room temperature.

✦ ✦ ✦

IN Figure 2 are seen a series of curves of the tensile strength of the copper-zinc alloys in various states from annealed to 10 B & S. Numbers hard, plotted against composition. The five curves for different degrees of anneal and the curve for lowest temper, 1 B & S Number hard, are very nearly straight. As the brasses are worked more and more severely, the effect of progressive zinc additions from 5% to 15% is much more prominent than equal amounts in excess of these values. The steepest ascending slope of the curves lie in the 5% to 15% range.

✦ ✦ ✦

FIGURE 3 presents two curves, one representing the electrical conductivity and the other thermal conductivity of the brasses covering the range of zinc additions from 0 to 50%. The striking thing to observe in this curve is the drastic decline in both conductivities with the first small additions of zinc. The drop in electrical conductivity for example, with the introduction of 5% zinc, is greater than the drop from 5% to 38% of zinc, the lowest value for the entire series. The two curves show an increase in conductivities beyond 39% zinc. This change in direction of the curves coincides with the appearance of the second phase in the alloy system. Alloys containing more than about 40% of zinc do not have physical properties desirable in wire, and therefore are seldom used in that form.

✦ ✦ ✦

FIGURE 4 is a typical microstructure of an annealing brass, in this instance carrying 20% zinc Figure 5 is a typical microstructure of the same brass drawn 12 B & S Numbers hard. Except for grain size developed by any given annealing treatment or color or etch tinting, the two micrographs can be considered typical of the whole ductile range of copper-zinc alloys. The differences in appearance of etched microspecimens of the different zinc alloys are more evident to the eye than in micro-photographs. They all have the same equiaxed polygonal structures when annealed or

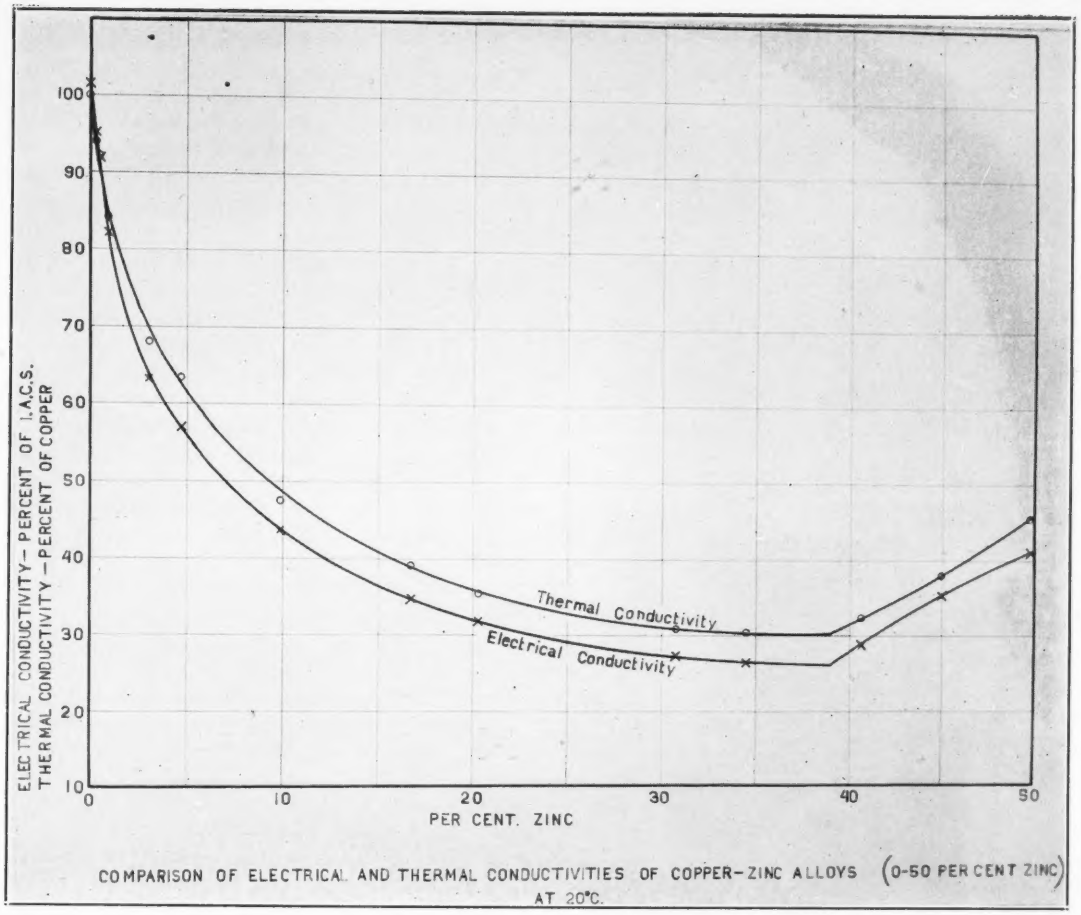

Figure 3. (After C. S. Smith).

parallel fibrous appearance when hard drawn that is characteristic of pure copper. The structures of all the hard drawn alloys return to the equiaxed crystallization when annealed.

FIG. 4. STRUCTURE ANNEALED RED BRASS WIRE .75 DIAMETERS.

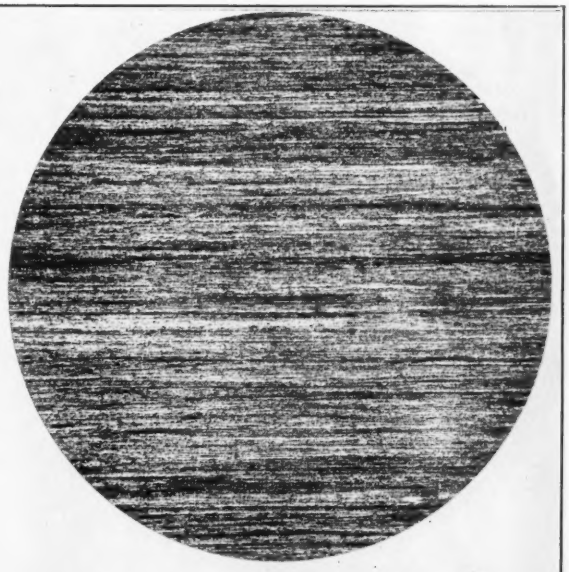

FIG. 5. STRUCTURE RED BRASS WIRE DRAWN 12 B&S NOS. HARD .75 DIAMETERS.

THE earlier reference to tin bronzes of 1.75% tin may be recalled in connection with Figure 3. It was stated that 1.75% of tin added to copper made an alloy possessing approximately 35% the electrical conductivity of copper. By contrast it is seen that an addition of 16% zinc is necessary to depress the conductivity an equal amount. 1% of Cadmium in copper reduces the conductivity about 15%, an effect slightly less than that produced by the same amount of zinc. The solubility limits for tin and Cadmium, however, are 10% and 2.7% at room temperature, respectively.

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THE effects of aluminum, nickel, manganese, silicon on the physical properties can be displayed in a manner similar to figures 2 and 3. Nickel stands by itself in this list of alloying elements, in that it forms a continuous series of ductile solid solution alloys throughout the entire range from pure copper to pure nickel. They are not all commercially valuable.

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IRON is commonly present in small amounts in the alloys of commercial manufacture, but is an impurity except in the case of the low copper welding alloys to be mentioned later.

ONE of the very important mechanical uses of non-ferrous wires is in the form of springs. Springs are made of those alloys possessing the best resilience when drawn 6 to 10 B & S Numbers hard. With the exception of one alloy we have not yet described, copper alloy springs have to be formed from hard wire, and therefore cannot be made of material having so great a resilience that it is difficult to coil or bend to the required shape. This very quality limits, to some extent, the uses to which the springs may be put The choice of a spring alloy will be governed by several considerations, having due regard for such limitations as permissible weight, available space, etc. From an engineering standpoint, endurance or fatigue limit of a spring material is of the greatest importance in any member subject to flexure or high mechanical stress. The shop man, on the other hand, wants a material easily manufactured to finished form. Both must be governed by cost. In many cases the final choice is a compromise. Electrical apparatus, for example, switches, meters, brush holders and the like, commonly use Phosphor Bronze Wire. Nickel silvers are often used for severe duty midum tension springs, and common brass for the less severe or lower cost requirements. Copper itself may be used to some extent for special purposes involving low loadings. Phosphor Bronze of the 5% tin type (Anaconda Grade A) or Everdur are better adapted for high unit loading.

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ALUMINUM bronzes, as a class, are not widely used for wire. The solubility limit of aluminum in copper is approximately 10%, but the hardening effect of aluminum is so great that it is difficult to draw into wire any alloy containing 2½% aluminum. An apparent exception is the ternary alloy copper-aluminum-tin, known as Calsun Bronze. This alloy carries 2.4% aluminum and 1.8% tin. It is readily made into wire of cable sizes, possessing strength above 125,000 lbs. per sq. in. Calsun Bronze cable is popular with the railroads for messengers supporting trolley wires and for reinforcing wire in copper feeder cable Figures 6 and 7 show the micro-structures of annealed and hard drawn Calsun Bronze, respectively. It will be seen that this ternary alloy possesses the same single phase polygonal structure annealed and fibrous grain hard drawn that were described earlier in connection with the simpler alloys

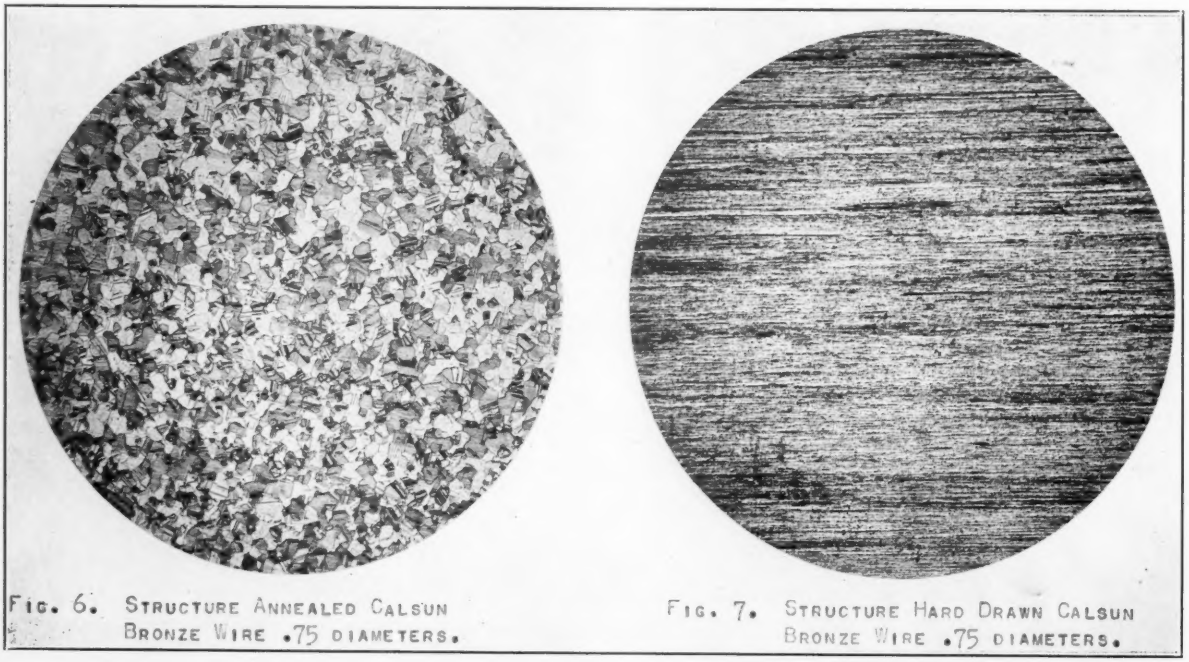

FIG. 6. STRUCTURE ANNEALED CALSUN BRONZE WIRE .75 DIAMETERS.

FIG. 7. STRUCTURE HARD DRAWN CALSUN BRONZE WIRE .75 DIAMETERS.

THE nickel-copper series is an important special usage type of alloy. Their higher cost has kept them from wide adoption for mechanical or structural application, although their properties would seem ideal for high loading and extreme exposure. The Cupro Nickels have relatively high electrical resistance, are slow to oxidize and maintain good strength at elevated temperatures. They are, in consequence, used for electric resistance coils and medium temperature heating elements. Monel Metal wire embodies many excellent high strength properties and finds some little application in both the electrical and mechanical construction. This alloy carries an appreciable percentage of iron. The Nickel Silvers, copper-nickel-zinc group, were formerly more widely used for electrical resistance purposes than they are today.

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A HEALTHY young member of the copper family is Everdur. This comparatively new alloy contains 3% silicon, 1% manganese, the balance copper. It possesses the high corrosion resistance of copper, but it far surpasses the parent metal in strength. Annealed Everdur wire has a tensile strength of upwards of 60,000 lbs. per sq. in. Tensiles of 180,000 lbs. to 200,000 lbs. can be obtained by servere cold drawing. Such very high values are, of course, accompanied by low elongations. Wire with good elongations, above 1% in 60", is made to tensile strength requirements of 120,000 lbs. per sq. in. minimum in B & S No. 1, 141,800 lbs. per sq. in. in No. 10 and 145,000 lbs. per sq. in. in No. 20 wire with the intermediate sizes taking proportional values between.

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AN interesting application of high strength Everdur wire .192" dia. is found in the flexible concrete mats used for bank and levee protection on the Mississippi River. Wire for this purpose must possess a minimum breaking strength of 4,000 lbs. It must bend sharply upon itself without failure, be capable of electric welding, and

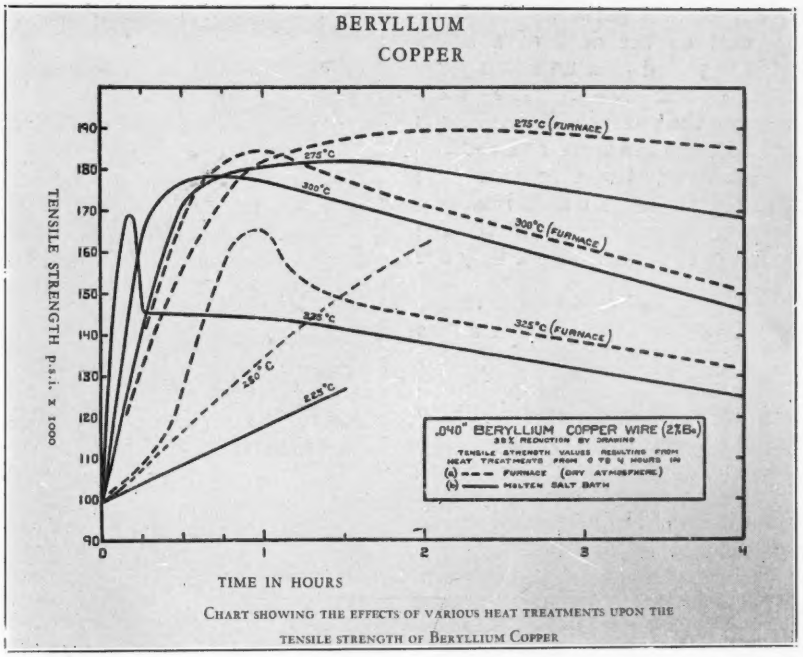

CHART SHOWING THE EFFECTS OF VARIOUS HEAT TREATMENTS UPON THE TENSILE STRENGTH OF BERYLLIUM COPPER

Figure 8. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

above all must withstand corrosion when exposed to Mississippi River water. The concrete mats are made with a built-up reinforcing mesh not unlike the reinforcement seen in concrete highway construction. The reinforcing wires run continuously thru twenty fourteen inch wide blocks with one inch spacing between. Transverse reinforcing loops project from the ends of the blocks and serve to tie ad-

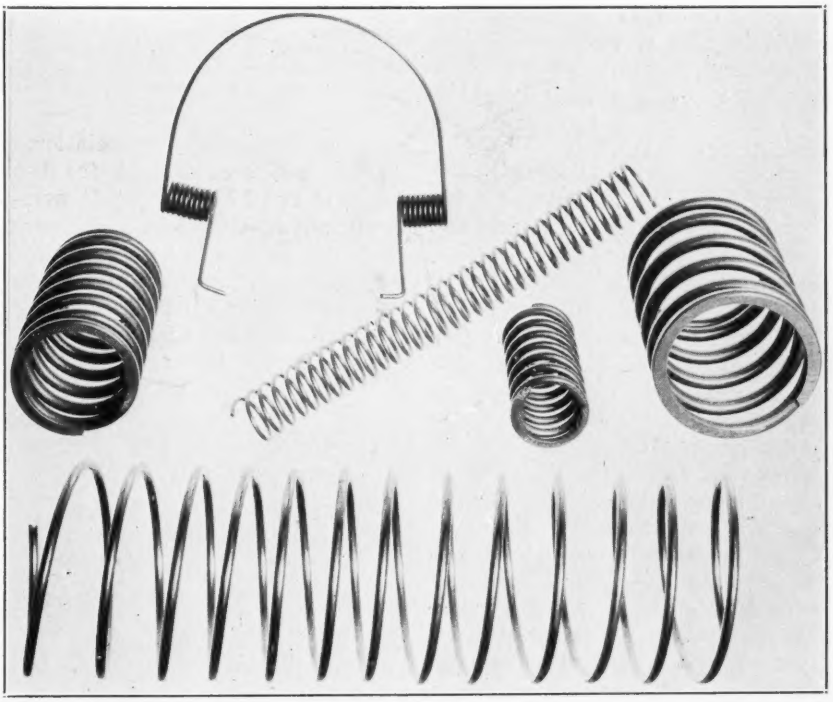

Figure 9. Groups of Beryllium Copper Springs. ✦ ✦ ✦ ✦ ✦ ✦

jacent mats together. The mats are cast on the deck of a barge and are pulled as a unit into place on the river bank. The wire crossing the spaces between blocks and between the mats and the ties are exposed to the river flow. The wire must retain its high breaking strength year after year if the mats are to remain where they are placed.

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THE newest of the copper alloys is Beryllium Copper. This metal contains 2.25% beryllium. It is unique in being susceptible to heat treatment, whereby the strength and hardness resulting from cold drawing can be greatly increased. Beryllium Copper is hardened by exposure of an hour or more to temperatures between 275° and 325° C. Wire drawn hard to a tensile strength of 100,000 lbs. per sq. in. can be heat treated to a strength of 180,000 lbs. per sq. in. Figure 8 shows graphically the effect of various heat treatments on Beryllium Copper having an initial tensile strength of 100,000 lbs. per sq. in.

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BERYLLIUM Copper readily lends itself to work that can best be formed from soft metal or metal of moderate temper, but that must be stiff or resilient or hard when ready for use. Figure 9 is a photograph of a typical group of Beryllium Copper springs manufactured commercially.

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COPPER alloy strand and cable has been used to a limited extent when compared with steel. The necessarily higher cost of copper working to its disadvantage. The greatest amount of copper alloy strand and cable has gone into electrical construction in which the utmost dependability is essential, and no chances can be taken with failures resulting from corrosion or arcing. High strength copper alloy strand is used extensively in steam railway electrification and high speed electric railway overhead construction. It is used for messenger cable supporting lead covered telephone and power cables in such localities as damp subways or river crossings where galvanized steel strand does not afford a sufficient factor of permanence. Only the towers and bridges of overhead construction on railways can be painted. The rest of the structure must be immune to acid from locomotive smoke or the wide variety of industrial fumes which drift across the right-of-way. Alloy strand is used for main and auxiliary messenger cable; for cross-span wires, pull-offs, etc. The amounts of such wire now in use and to be required for proposed work, is impressive. The following data have been taken from the 1930 Report on Electrification of Steam Railroads, National Electric Light Association and the Reports of the Committee on Catenary Specifications 1930 and 1931 of the American Electric Railway Association.

THE indicated weight for the first two 3000 Volt D. C. overhead constructions is approximately 20,000 pounds per mile, and for 11000 Volt A. C. construction from 9,700 pounds to 11,700 pounds per mile. Except for the use of composite main messenger cables these weights do not include the metal in power lines, feeders, and auxiliaries The two heavier structures also employ twin 4/0 contact wires.

A REPORT issued by the Copper & Brass Research Association, in 1930, contains the estimates of amounts of copper utilized by steam railway electrification in the United States. See table III.

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TO this can be added some 20,000,000 lbs. of copper used for transmission by power companies, bringing the grand total up to 110,000,000 lbs. This total does not differentiate between copper and copper alloy. Not included in the foregoing, is the work on the Pennsylvania Railroad from New York to Washington, which was estimated (the Electric World June 18, 1932) would absorb 38,000,000 lbs. more copper.

TABLE II

Copper in Overhead Catenary Structures of Representative Electrified Steam Railroads

Cleveland Union Terminals	Union Station and approaches
Track Mileage	60
Type of power	3000 Volt D. C.
Catenary Weight	3.88 lbs. per foot
Delaware, Lackawanna & Western Ry.	Suburban District
Track Mileage	112
Type of power	3000 Volt D. C.
Catenary Weight	3.49 lbs. per foot
Reading	Suburban Dist. & Terminal
Track Mileage	100
Type of power	11000 Volt., 25 cycle
Catenary Weight	1.86 lbs. per foot
Pennsylvania Railroad	Main Line and Terminals
Track Mileage—when complete	2759
Type of power	11000 Volt., 25 cycle
Catenary Weight	2.146 & 2.29 lbs. per foot

IN figure 10 is seen a typical view of the construction on a double track section of the Cleveland Union Terminal. The 7/8" dia. main messenger cable of Calsun Bronze and hard drawn copper wires are clearly seen supporting a 19-wire Auxiliary Messenger, which in turn carries 4/0 Hitenso "C" trolley wires. A lighter messenger cable is seen at the pole top carrying a lead covered cable. The 7/8" main messenger cable is

TABLE III

Estimate of Copper as Copper and Alloy used on Electrified Steam Railroads in the United States to 1930

For transmission	20,000,000 lbs.
For conversion (substations overhead system)	6,000,000 lbs.
For distribution (substations overhead system)	42,500,000 lbs.
For equipment	21,500,000 lbs.
	90,000,000 lbs.

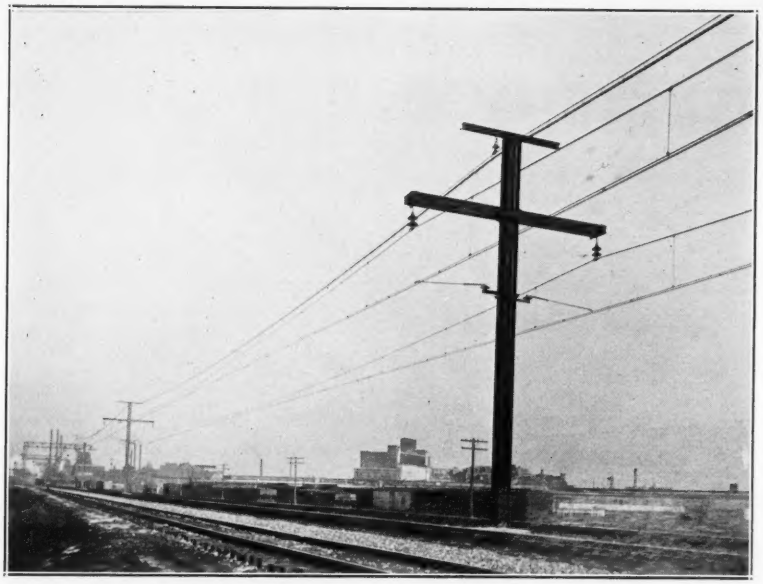

Figure 10. Typical Railroad Construction.

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an interesting combination of a 19-wire core stranded of hard drawn Calsun Bronze wires 0.1202″ dia. in two layers and a 16-wire outer layer of hard drawn copper 0.1387″ dia. The cable serves both as a feeder and as a messenger. It has a minimum breaking strength of 39,320 lbs. Main messengers embodying the same principal, are utilized by the Lackawanna and the Reading Railroads. This combination of duties in the messenger cable results in a simplified overhead structure.

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FIGURE II details the catenary construction of the Pennsylvania Railroad. The main messenger is ⅝″ dia. Calsun Bronze or high strength Silicon Bronze cable built up of 19 wires 0.125″ dia. The required minimum breaking strength is 24,000 lbs. The auxiliary messenger adopted by the Pennsylvania Railroad engineers is a 4/0 grooved trolley wire, supporting a 4/0 grooved contact wire by clips spaced between the suspender loops.

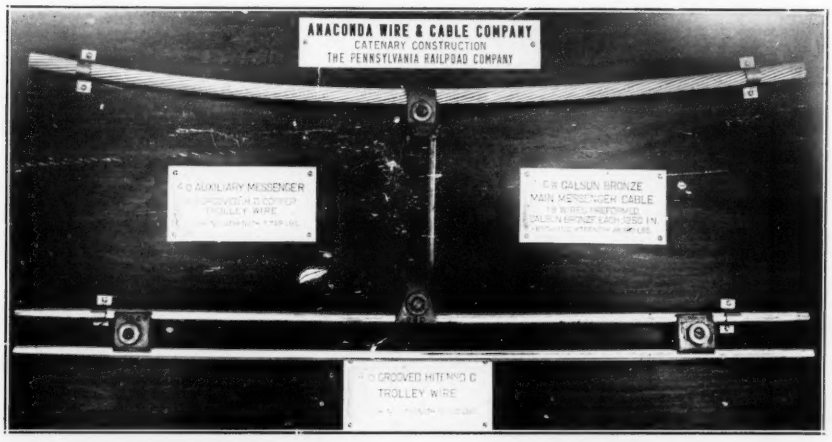

Figure 11. Details of Catenary Construction of Pennsylvania Railroad.

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THE American Bureau of Metal Statistics Year Book for 1932 reports the estimated use of copper in the United States (Table XXXIV) for the past four years as follows: (See table IV).

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OF the total 3,125,950 tons, 1,812,200 tons or 58% went into Electrical manufactures, telephones and telegraphs, light and power lines (including bus bars), wire cloth and other wire.

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MANY alloys are produced and marketed in wire form for convenience only. They are raw material for subsequent manufacture or consumption, and may not possess the valuable properties normally associated with wire. The brasses claim attention here again.

TABLE IV

Consumption of Copper in Wire, Wire Products and Related Materials in the United States

1929	1,159,800 tons	19.08 pounds per person
1930	956,150 tons	15.52 pounds per person
1931	650,000 tons	10.43 pounds per person
1932	360,000 tons	5.77 pounds per person

Various members of that group are used for heading into rivets, screws, nails, pins, balls and the hundred products of rivet machines. The leaded brasses, so much used for their free turning qualities, are supplied as wire in coils in the smaller sizes.

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ANOTHER important division is that of the welding rods or wire. To the welding trade these metals are "rods" or "wire" according to whether they go to market in straight lengths or in coils. Basically they are all wire, since they are finished to size by drawing in coils. Among the welding alloys are a number of low copper contents, carrying in addition to zinc, tin, manganese and iron. Many make welds of high strength and hardness. They resist mechanical wear. These alloys are called Manganese Bronzes. Also to be mentioned under the head of welding metals, are Silicon Copper, Phosphor Bronze, Tobin Bronze, Everdur, Monel Metal

(*Please turn to page 342*)

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THE WIRE ASSOCIATION

The Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, credit men, salesmen, and all others engaged in the wire industry, together with manufacturers, and other interested people who have something to sell to the wire mill or some service to render for pay.

Its specific purpose is to improve production methods and afford a clearing house for ideas on management problems, technical problems, and research work in all phases of practical wire drawing and wire working, and to develop and maintain friendly relations among the members.

✦ ✦ ✦

ACTIVITIES:

The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Standardization and simplification as a means for the effective elimination of waste, including:
8. Such other subjects as may be determined upon.

AN INVITATION IS EXTENDED TO YOU TO BECOME A MEMBER

✦ ✦ ✦

Annual Dues $10.00 Per Year

THE WIRE ASSOCIATION, 17 E. 42nd ST., NEW YORK, N. Y.

The undersigned hereby applies for membership in the Wire Association, and agrees to be governed by the Charter and By-Laws of the Society and to further its objects as laid down therein.

Name .....
(*Firm, Organization or Individual applicant*)

Address .....

Nature of Business .....

Name of Organization .....

Address of Organization .....

Applicant's Title or Occupation .....

Teamwork in Industry

By Frank W. Bullock

1st Lieut. Signal Corps, U. S. Army

(Member of the Wire Association)

A comparative study of Trade Organizations for the control of competition in industry, as found in Europe, and as made possible in America by the National Industrial Recovery Act. A paper prepared by the Wire Association.

"The highest and best form of efficiency is the spontaneous co-operation of a free people."---Woodrow Wilson.

AN eminent politico-economist, discussing the social and economic chaos of post war Europe, remarked that in our present day civilization, economic necessity should be regarded as the foundation of all social and political organization. Although this theory is manifestly inaccurate, it is illustrative of a very obvious trend in political and economic thought. The most casual observer cannot fail to recognize the fact that social, political, and economic problems are constantly acquiring a more intimate relationship one with another. Certainly the part played by Government in the business community is one of ever increasing importance, while in the field of international politics, the problems of economic relations have become the most important element in post war diplomacy.

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IF one may venture a generalization, it may be safely asserted that in the present day structure of world economy, no enterprise, no community and no nation is or can be strategically or economically self sufficient. Business has long since overflowed international boundaries. The very existence of all industries in all countries has become directly or indirectly dependent upon foreign sources of supply and foreign markets for their products. In such a situation it is apparent that uncontrolled competition in industry must inevitably lead to economic, social and political self destructon. It requires no stretch of imagination to conclude that the future of our civilization no less than the solution of our immediate social and economic problems depends upon the regulation and control, voluntary or enforced, of every element of our industrial structure.

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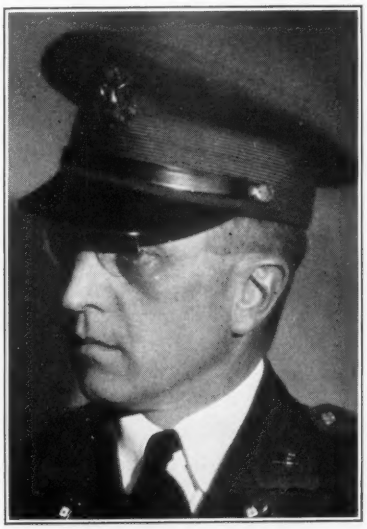
THIS doctrine is by no means new, nor does it involve any venture into unexplored fields of economic theory. Industrial control is as old as civilization, and has from the beginning been an accepted function of organized society. It is not the purpose of this paper to argue the merits or demerits of any particular theory of industrial control. Moreover the necessary limitations of time and space do not permit the discussion of specific systems in other than the most general terms. However, a study of past and current experiments in industrial control discloses fundamental points of similarity not only with respect to the kind of control, but also with respect to the means by which control is effectuated. It is the purpose of this study to set up for comparison some of the significant features of typical systems of industrial control already in operation in foreign countries, with the American Idea as expressed in the National Industrial Recovery Act in the hope that by this method the essential similarity of the two philosophies may become apparent.



FRANK W. BULLOCK
1st Lieut. Signal Corps, U. S. Army
Research Student at Harvard School of Business Administration.
(Member of the Wire Association)

✦ ✦ ✦

What is Industrial Control?

REDUCED to its simplest terms, industrial control is of three kinds, first, technological, second, financial, and third, political. In practice of course, the regulation of industry and commerce cannot be thus simplified. Basic controlling influences never operate singly, and operating in combination, these forces assume an infinite variety of forms.

✦ ✦ ✦

Technological Control

OLDEST in point of time is technological control which

Save on Your

Winding Costs

With Winco PRODUCTS Leakproof Enameled Wire

▲ ▲ ▲ All wire meets the most exacting requirements ▲ ▲ ▲

Your product will improve in

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Winco PRODUCTS LEAKPROOF ENAMELED WIRE

A wire made to the highest standard of uniformity in regard to dimensions, electrical properties and resistance to abrasions.

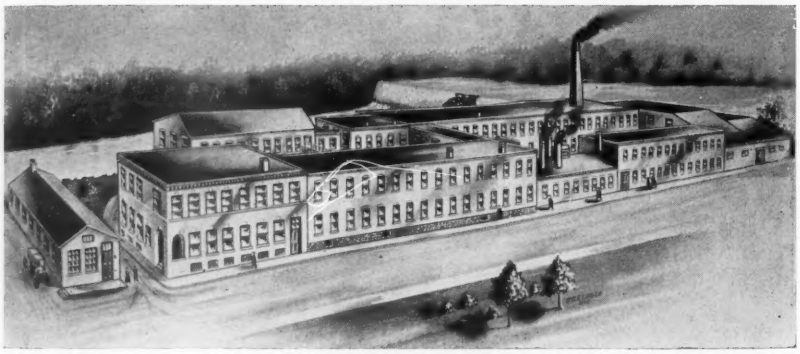
Allows of multiple winding without bunching, wrinkling or breaking of papers.

Permits the coil designor to calculate wire space accurately.

The ample coating of high dielectric enamel insures against the destructive effect of leakage currents, materially increasing the life of coils.

The enamel is especially resistant to the softening action of impregnating and baking compounds.

Write for samples.



GENERAL VIEW OF PLANT, WINSTED, CONN. ▲ ▲ ▲

Products of leakage currents attack insulation and shorten the life of the coil. ▲ ▲

The only test indicating what the leakage loss in a winding may be is the test in mercury, which reveals the weak spots in the enamel covering. ▲ ▲ ▲

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Specially Processed Copper Wire...

For Enameling Purposes...

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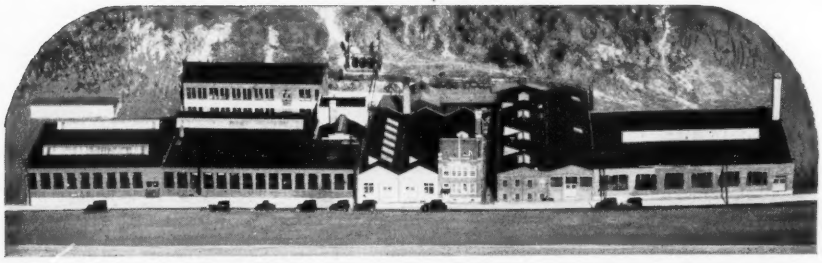

AERIAL VIEW OF PLANT OF HUDSON WIRE CO., OSSINING, N. Y. ▲ ▲ ▲
▼ ▼ ▼ FINE WIRE MANUFACTURERS ▼ ▼ ▼

"HUDCO" High Conductivity Electric Wire

OTHER FINE BARE WIRES

High Brass, Low Brass, Zinc 99.99+ and High Tensile Zinc, Commercial Bronze Phosphor Bronze, Pure Tin, Lead, Antimonial Lead, Cadmium, 10%, 18% and 30% Nickel Silver, Silver Plated Copper, False Gold and Special Brass and Bronze Alloys to Specification.

BRUSH WIRES, CRIMP and STRAIGHT

Brass, Steel, Nickel Silver, Copper and Phosphor Bronze

TINSEL LAHNS

Silver Plated Copper, False Gold and Copper

METALLIC FIBRE FOR PACKING PURPOSES

Copper, Bronze, Zinc, Lead and Aluminum

Wires for Metal Sprays

Zinc, Tin, Lead, Copper, Commercial Bronze, High Brass, Low Brass, Cadmium, 10% Nickel Silver, 18% Nickel Silver, Aluminum, Monel Metal, Phosphor Bronze, Pure Nickel. Other wires to specification.

"Hudco" copper wire is drawn by the Hudson Wire Company of Ossining, N. Y., who have been specialists in the manufacture of fine wires for over thirty years. ▲

The best grade of copper drawing stock is used, insuring the maximum conductivity. ▲ ▲ ▲

A new process of drawing and annealing is used which produces a wire unusually smooth, clean and uniform in color for enameling and other purposes. ▲ ▲ ▲

Painstaking care in the selection and maintenance of dies guarantees a product accurate to gauge and resistance. ▲ ▲ ▲

You can rely on "Hudco" wire always. ▲ ▲ ▲

Expert annealing of the wire prevents unnecessary breakage when winding the wire into coils. ▲ ▲ ▲

If you, too, have a specific problem demanding wire of exact requirements, write to us about it. ▲ ▲ ▲

It costs nothing and involves you in nothing. ▲ ▲ ▲

Better wire at lower cost. ▲ ▲ ▲

"HUDCO"
FINE WIRES

We can serve you quickly and economically.
Send in your specifications for a quotation.

HUDSON WIRE COMPANY

Ossining, N. Y.

Estab. 1902 — Successors ROYLE & AKIN — Estab. 1902

"HUDCO"
FINE WIRES

antedates by many years the so called "factory system". Historically, this type of control is best illustrated by the working of the "Crafts Guilds" of ancient times. By banding themselves together in these associations, skilled artisans sought to control and regulate the exercise of their vocations. The technique of their craft was jealously guarded. Wages and conditions of labor were set up and the perpetuation of their craft was provided for by an elaborate system of apprenticeship. This form of control did not operate alone. Almost from their inception, guilds acquired a recognized legal and social status under which their acts were enforceable by recourse to the political power. In modern times we see technological control over industry effectuated through the operation of the patent laws of nations, through the establishment of legal standards of quality for commodities, and by direct government supervision of productive processes.

✦ ✦ ✦

Financial Control

FINANCIAL control of industry implies some form of proprietory interest. This may consist of the physical ownership of natural resources and productive facilities, in which case control is direct and absolute, or it may be effected by means of an infinite number and variety of financial operations including government manipulation of currencies and credit.

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Political Control

ONE may be accused of hair splitting for presuming to treat political control of industry as a separate entity, since it invariably follows and supplements the forces of control already mentioned. For the purpose of this study, the word 'political' should be construed in a much broader sense than that commonly accepted. Political control and governmental control are not synonymous terms. Political control connotes community of purpose, collective thought and cooperative effort. It implies the voluntary or involuntary subordination of individual interests for the accomplishment of a common purpose, and a surrender of a great or lesser measure of individual freedom of action. It is immaterial whether the motivating force is the result of voluntary agreement between individuals, or the police power of government. Considered thus broadly, political control of industry appears in many forms. For example we find numerous instances of public ownership of natural resources, resulting in controlled production and enforced conservation. Public ownership and operation of certain public utilities such as our own Postoffice Department and government regulation of transportation and communication facilities is found in nearly every country in the world. In addition to governmental and quasi-governmental agencies for the control of industrial enterprises, there are numerous private agencies performing similar regulatory functions. Included in this category are such organizations as the stock exchanges, trade associations, technical societies, marketing cooperatives, cartels and labor unions. The influence exercised upon industry by these agencies is in a sense, direct, but indirect and frequently unrecognized forces of political control are of no less importance. Such indirect control is illustrated by instances of strategic control by certain Powers of trade channels, international communications, and marketing facilities.

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The Doctrine of Karl Marx

KARL Marx in his day, advanced the doctrine that a completely cooperative social and industrial community is the natural and inevitable result of the unregulated working of the competitive system. In this theory there is a substantial element of truth, but like all partial truths, it is often misinterpreted. The earnest though unwashed followers of Karl Marx who vociferously inform the world that our entire social system is headed for the 'demnition bowwows' overlook the fact that lacking the motivating force of personal profits, there can be no such thing as industrial enterprise. And overlooking the fundamental fact, they naturally overlook its corollary, namely, that the acquisitive instinct if deprived of the stimulus of healthy competition, in time ceases to assert itself. If then we acknowledge the truth in Dr. Marx' theory, that unrestricted competition is fatal to industry, we must do so with the qualification that the complete regimentation or communization of industry is no less fatal.

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THE acceptance of this doctrine points to a very natural conclusion, that somewhere between the doctrine of 'laizzez faire' and the opposing extremes of Fascism or Communism, there exists some degree of industrial control under which a workable system can be developed capable of assuring to business men, workers and society as a whole an opportunity to attain an enduring prosperity. For many years, statesmen, economists, and business men have been seeking by trial and error, to develop such a system. Now, in the form of the National Industrial Recovery Act, the United States has set before the world an ambitious and comprehensive plan for industrial rehabilitation. This plan has brought forth widely different reactions in the public mind. Liberal thinkers are in the main, favorably disposed and willing to cooperate in its execution. Farmers and wage earners see in it direct personal benefits to them at someone else's expense. Radicals condemn it as hopelessly reactionary, and conservatives shake their heads over what they consider a desperate experiment.

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Common Characteristics

AS has been suggested earlier in this study, there are three basic forces for industrial control. Similarly, every experiment in in-

dustrial control so far undertaken possesses three common characteristics which may be described as 'Combination', 'Organization', and 'Police Power'.

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Philosophies of Industrial Combinations

WITH respect to industrial combination, we find as between the leading nations of the world, two widely different philosophies. In the United States, the so called anti trust policy which found its first legislative expression in the Sherman Act of 1890, and in the later Clayton Act, confirmed in numerous court and administrative actions, is too well known to require discussion. This anti trust policy has not been entirely inflexible, but has been modified from time to time to meet changing conditions. For example, the provisions of the Sherman Act were to all intents and purposes set aside by the War Industries Board in 1917 and 1918, to speed up war production. Similarly the law was liberalized with respect to foreign trade by the Webb-Pomerene Act of 1918. However, prior to the adoption of the National Industrial Recovery Act, the American policy with respect to industrial combination was relatively more restrictive than that of the other leading industrial nations of the world. True, in Great Britain, the old common law doctrine of 'restraint of trade' remains in effect, and in many other countries there are laws designed to restrict what we term 'unfair trade practices', but in general it may be safely asserted that in all other leading countries, industrial and commercial combinations could be effected more freely than in the United States.

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History of Industrial Control

SURVEYING the history of organization for industrial control, it is interesting to note that while the functions of control are primarily national and deal with domestic competition, the earliest attempts at organization for control had for their objective the regulation and facilitation of international trade. Professor Donaldson has estimated that immediately prior to the World War, there were in operation in countries other than the United States, not less than 2500 combinations for regulating prices or otherwise controlling international trade. Strange though it may seem, the war did not check, but rather accellerated the growth of such organizations.

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Working Organization

WITH respect to their working organization, combinations for the regulation of industry conform to no typical pattern. For example, in the United States and the British Dominions, such combinations have almost without exception been built upon the principle of financial control, and have appeared as mergers, horizontal and vertical trusts, holding companies and marketing syndicates. In most instances the apparent objective of such combinations has not been regulated competition, but absolute monopoly. In Great Britain and Japan, industrial combinations have most often been of gradual formation by a process of amalgamation of related family or financial groups, while in France, Belgium, Sweden, and Russia, forced syndication under government control is by no means uncommon. On the other hand, in Germany, where the success of the industrial combination movement has been noteworthy, the cartel form of organization is most typical.

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The Cartel

CONTRARY to popular belief, the cartel is a relatively loose knit organization which operates on the principle of voluntary individual self-regulation, under rules which are enforceable by the will of the majority of the group. Membership in such organizations is entirely voluntary, and members are at liberty to withdraw with little or no formality. It has been suggested that the apparent weakness of the cartel organization may to a large measure explain its recent success. This theory is not without some measure of justification. It is of interest to note that in Germany during the hectic years immediately following the war, which witnessed the collapse of two of the greatest financial combines of modern times, approximately 1600 cartels survived, and are to day in successful operation.

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THE **National Industrial Recovery Act** has removed nearly every restriction placed upon individual or collective freedom of action in business by law and custom. This discloses the unmistakable intent that Industry must set its own house in order. As perhaps the best illustration of industrial self regulation, the typical business cartel deserves special treatment.

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What Is A Cartel?

A CARTEL has been defined as "A voluntary organiation among independent producers each retaining a large measure of individual freedom of action, designed to control and combat excessive competition." "Membership in a cartel is a contractual relationship enforceable at law or in equity where no governing statute exists."

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THE cartel is essentially a 'child of adversity' which thrives best under conditions of economic depression. Membership in a cartel does not affect the freedom of any producer with respect to the financial operations of his business. It does, however, limit his freedom of action in the technical and commercial operations of his business. In theory at least, he obligates himself to surrender certain tangible or intangible individual advantages in exchange for a pre-determined share in greater collective advantages. Cartel agreements are definitely limited both as to conditions and

time, but are usually renewable at the option of the member. Membership may be terminated by agreement just as any other contract. Most agreements include provisions for definite penalties in the event of violations on the part of members, and in some, specific conditions under which recourse may be had to legal action, are set forth.

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Kinds of Cartels

CARTEL agreements or codes fall into five general classes, necessarily somewhat vague, and nearly always overlapping to a greater or less extent.

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1. THE "Conditions" Cartel is designed to regulate marketing conditions by setting up a code governing standard forms of contract, sales agreements, sample policy, terms of payment, delivery, discounts, rebates, grading, packing, insurance, returned goods, claims and adjustments. This type of agreement usually provides for some form of supervision through a system of reports, the accuracy of which is left entirely to the good faith of the individual member. This is perhaps the loosest form of cartel organization, since it seeks to exercise no control over price competition Cartels of this type have been moderately successful particularly in international trade.

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2. THE "Price" Cartel is the natural complement of the 'conditions' agreement and is ineffective except in conjunction therewith. The price cartel seeks to establish and stabilize prices at levels which will assure producers the highest net return for their products. This policy differs materially from the monopoly idea of charging all that the traffic will bear. It introduces a new element in cooperative control, namely the scientific determination of prices, based upon technical and statistical research. This type of cartel usually includes in its code, provision for the support of a central agency for the study of costs, production methods, styles, standardization, market conditions, trends, and competitive influences. The price cartel is the most versatile form of organization with respect to all types of industry. It has not enjoyed any conspicuous success, which fact is largely attributable to two fundamental weaknesses. First, the price cartel exercises no limiting influence on production, and second, it is imperfectly understood and often looked upon with suspicion by the buying public, a condition which renders it extremely vulnerable to supplentive competition.

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3. THE "Production" Cartel offers the most comprehensive scheme of industrial self regulation. It seeks to control competition by one or a combination of three methods:

(1) By territorial allocation of markets. In practice this usually consists of setting aside certain areas adjacent to centers of production as 'restricted' territories, and limiting competition in the remaining 'neutral' territories by means of a system of 'basing point' prices, or by definite sales quotas.

(2) By direct limitation of production. This method involves the establishment of production quotas based on scientific estimates of probable consumption. Adherence to quota limitations is enforced by a system of penalties for overproduction. Funds collected as penalties are returned to members in the form of bonuses for under production within the quota agreement.

(3) By the creation of a central marketing agency which represents the industry in domestic and foreign markets.

The production or limiting cartel is the most effective of voluntary regulatory organization. It affords important advantages to members in the form of opportunities for specialized production, and in economies resulting from stable prices and assured volume of business. Cartels of this type have been most successful in the heavy industries such as coal and steel where products are standardized to a degree which permits the shifting of sources of supply without affecting the ultimate user, and where the products are of such character that supplantive substitution is difficult or impossible.

4. The Cartel for the Protection of Trade Marks, is of relatively rare occurrance. In it, manufacturers pool their trademarks and enter into an agreement not to sell to any dealer, wholesale or retail, who sells or displays for sale any branded article at a price lower than that prescribed by the cartel. This type of organization is definitely a 'combination in restraint of trade' within the interpretation of our laws, and even where permitted to operate is seldom successful.

5. The "Contracts" Cartel is in effect a monopoly created by agreement. It can best be described by a hypothetical illustration. Suppose the City of New York invited bids for the furnishing of a large quantity of structural steel. The Steel Cartel would study the requirements covered by the proposal, allocate to its members their pro rata share of the production set a price at the limit beyond which the project would be abandoned rather than pay it, and then submit one and only one bid for the entire steel industry in the name of the cartel, with a cynical "take it or leave it." In international trade, the smothering of competition in this manner is by no means uncommon, fortunately that sort of trade piracy invariably over-reaches itself, and the industry suffers.

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How Does A Cartel Police And Defend Itself?

AGAINST the unruly member the cartel has at its disposal a wide choice of weapons, some of which are the witholding of credit, control of machinery, the manipulation of patents, labor agreements, and as a last resort appeal to the courts. Against the non member, the cartel has but one weapon and needs but one, namely price warfare. No individual producer is strong enough to defeat the organized majority of his industrial group in a battle of prices.

Legal Status of Cartels

FROM the establishment of the first trade cartel in the early 1850's, these organizations have been the orphan child of most of the legal systems of the world. In fact until our Congress adopted the National Industrial Recovery Act, only two nations had ever attempted to regularize by legislative enactment, the status of voluntary trade organizations of this type. In 1923 the German Reichstag, passed a law which in addition to defining the status of cartels, provided authority for the enforcement of agreements entered into by such organizations. For the review of agreements and the hearing of disputes affecting public interest, the law provided for the creation of a governing commission (Kartell Gericht). This body sits as a sort of board of arbitration, it advises rather than directs, but its decisions respecting the public interest have the effect of law. In 1924 the Norwegian parliament adopted a similar law, which, however differs from the German statute in two important particulars. It provides that before a cartel my be organized, a license must be obtained from the (Control Directorat) an agency not unlike our own Recovery Administration. The law also denies the license provilege to any price cartel, or to any cartel which resorts to direct action against non members.

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FROM this sketchy discription it will be noted that the cartel type of organization posesses in a most democratic form, all three of the basic elements found in all agencies for industrial control, combination, organization and police power.

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CARTELS, however, succeed only so long as they contribute to the efficiency and prosperity of their members and the public. To be strong and effective, a cartel must be in every way representative of the industry it seeks to regulate. It must comply in letter and in spirit with all laws and regulations adopted in the public interest. Finally if it wishes to enjoy the public confidence, it must demonstrate its ability to preserve order in its own house.

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The National Industrial Recovery Act

TURNING to the **National Industrial Recovery Act**, it is interesting to note how closely the typical trade cartel conforms to the purposes and plans set forth in that act. Senator Wagner defines the purposes of the Act as:

1. The elimination of unfair competitive practices.

2. The reduction and relief of unemployment.

3. The improvement of the standards of labor.

4. The rehabilitation of industry.

5. The conservation of national resources.

Directly or indirectly, these are the objectives of every industrial cartel.

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The Operative Plan

THE operative plan embodied in the act is based upon the principle of industrial self regulation. With the prohibitions imposed by the anti trust laws temporarily suspended, industrial groups are offered every incentive to form combinations. By defining the scope and purpose of codes of fair competition, the law has given to industry a workable plan of control organization. And lastly, to the self imposed police power available to industrial groups, the law has added the entire weight of the Federal Government.

From this comparison it becomes apparent that in its fundamentals, the National Industrial Recovery Act embodies no untried theories. The principles enunciated have been fully demonstrated by experience gained at the expense of generations of costly trial and error.

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Conclusions

AMERICAN Industry has long boasted of its ability to police itself and to present a united front to the world. It now has the opportunity to make good that boast.

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AMERICAN Labor has for generations demanded protection against wage exploitation, for the right to bargain collectively on terms of employment, for security against unemployment, and for higher working and living standards. The Government has now done its part in bringing about the desired conditions.

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AMERICANS in every walk of life, have boasted our self sufficiency before the world, and loudly proclaimed our ability to accomplish great things. The "New Deal" opens up unlimited possibilities for either good or evil. It is at once an opportunity and a challenge. The past, with its mistakes is dead, the future is our responsibility.

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Editor's Note—In connection with this paper attention is called to the code presented by the Association of Wire, Rod & Tube Die Manufacturers.

This is printed in complete form on the pages immediately following.

Joint Code of Fair Competition for the Wire, Rod and Tube Die Industry

As Submitted by

Association of Wire, Rod and Tube Die Manufacturers, Inc.

Definitions

I. The National Industrial Recovery Act, when referred to in this document shall be called the Act.

The Association of Wire, Rod and Tube Die Manufacturers, Inc., when referred to in this document, shall be called the Association.

The word **"Die"** when used in this document, shall mean drawing die as here defined. A drawing die is a tool used for the elongation or deforming of wire rod or tubing, thereby changing its diameter or shape, and manufactured of diamonds, various carbides, steel and chilled iron or other similar abrasive resisting alloys.

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Purpose

2. The purpose of this Code is to effectuate the policy of the Act; to improve labor conditions and to increase employment; to eliminate unfair competitive practices among die manufacturers and their sales agents and representatives and to protect the United States die industry against the sale in the United States market by foreign manufacturers at such prices or on such terms or under such conditions as tend to destroy the industry in the United States or impair the standard of living among workers in the die plants of our Country.

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Constitution and By-laws

3. The Association has adopted a Constitution and By-Laws, a copy of which is attached.

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Membership

4. The Association will welcome as members all companies manufacturing dies in whole or in part in this country or dealers and importers of dies who will subscribe to the Articles of Organization and By-Laws and pay their proportionate share of the expenses of the Association.

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Code Modification

5. This Code, and any agreement made thereunder, or any license approved, prescribed, or connected therewith, is subject to cancellation or modification by the President of the United States, in accordance with the provisions of Section 10 (b) of the Act. Subject to the approval of the President, the Code may be amended by vote of the members in the manner prescribed for amendment of the By-Laws.

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Labor

6. The following provisions shall apply in respect to the manufacture of dies in the United States: that employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

That no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organization of his own choosing.

That employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

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Statistics

7. It shall be the duty of each person engaged in the industry to furnish to the Association such data as may be required as herein provided and failure to furnish the required data, or the furnishing of false or misleading information, or the making of false statements relating thereto, shall be regarded as a violation of this code of Fair Competition. It shall be the duty of each person engaged in the industry to furnish to the Association such current information concerning wage rates, hours of work, stocks on hand, sales and sales prices as may be required to enable the Association, or any agency on behalf of the Association to determine conditions within the industry.

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Production

8. Since dies are made only against customers' orders and since demand cannot be anticipated because of the wide variation in drafting practice and tolerances, no regulation of production is proposed.

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Trade Customs and Practices

9. (a) No parts nor contrivances or accessories for the improvement of drawing of rod wire or tubing shall be given to customers or sold to customers for less than cost plus a fair profit so as to influence the customer, to the detriment of this Code.

(b) No dies shall be delivered to customers for trial.

(c) Dies shall be delivered to customer only against customer's orders. This specifically prohibits the delivery of dies to customers on memo invoice or on consignment. Any dies shipped on consignment or on memo invoice shall constitute a violation of this Code of Fair Competition.

(d) There shall be no quantity discount or rebates, nor any salvage or second hand or used die allowances.

(e) Terms shall be 2%—10 days, net 30 days.

(f) Guarantees on dies have been a roundabout method of price cutting. Since all dies are made against customers' orders, the customer must reject within 15 days after date of delivery or shall be conclusively deemed to have accepted the same as sound and merchantable. No guarantee as to production, life, performance or against breakage shall be given.

(g) There shall be no misbranding of dies.

(h) There shall be no false invoicing.

(i) There shall be no price discrimination.

(j) Penalties for all infractions of the Code shall be imposed by the Advisory Committee as provided in the By-Laws. The amount of the penalty shall be in every instance the total amount of the sale as a result of which the infraction of the Code occurred or for dies on trial or on memo invoice, the total list prices of the die or dies delivered on trial or on memo invoice. The penalty shall be due and payable by the offending member upon notice of the Advisory Committee that the violation has occurred. In the event of repeated violations on the part of one member the infractions will be submitted to the proper governmental authorities for action.

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Minimum Wage

10. The minimum pay shall be 40c per hour for all employees in the industry.

Hours of Labor

11. Employees engaged in die production, paid on any hourly basis, except those employees engaged in an executive, sales or supervisory capacity or in office work or as watchmen, cleaners and messengers, shall not work more than eight hours a day or forty hours a week, except for time spent in repairs to equipment.

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Agreements

12. All members shall submit to the Secretary of the Association within ten days after taking effect of the Code, a list of all contracts, commitments, order or agreements for shipment of merchandise. All such lists shall be submitted by the members to the Secretary in sealed envelopes to be kept closed by him until such time as complaint may be made against any one of the members involving unfair practice pertaining to pre-dating of contracts, commitments, orders or agreements for shipment of merchandise and shall then be opened only by the Advisory Committee in the presence of the Secretary, and then resealed in his presence and redelivered to the Secretary.

Notwithstanding any other provision contained in this Code, the fulfillment of written agreement between die manufacturers, dealers, agents and/or representatives in dies, and any other persons or corporations signed and in effect June 16, 1933, shall not be considered to be in conflict with the provisions of this Code nor an unfair practice under its terms. Provisions of contract not actually signed prior to June 16, 1933, shall be superseded by provisions established under this Code or any amendment thereof or otherwise under the Act as far as there is any inconsistency between such provisions.

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Code Violation

13. To further effectuate the policies of the Act, the Advisory Committee of the Association or such other committee or such successor committee or committees as hereafter may be constituted by the Association for that purpose, is set up to cooperate with the President of the United States as a planning and fair practice agency for the die industry and to cooperate with the President of the United States in making investigations as to the functions and observances of any of the provisions of this Code, both at its own instance, or on complaint by any person affected, and to report the same to the President of the United States.

Such agency is also set up for the purpose of investigating and informing the Administrator on behalf of the die industry as to the importations of competitive articles into the United States in substantial quantities or increasing ratio to domestic production on such terms or under such conditions as to render ineffective or seriously to endanger the maintenance of this Code, and as an agency for making complaint to the President on behalf of the die industry, under the provisions of the Act with respect thereto. Such Agency may from time to time present to the President recommendations based on conditions in the industry as they may develop from time to time, which will tend to effectuate the operations of the provisions of this Code and the policy of the Act.

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Effective Date

14. This Code shall become effective ten (10) days after approval by the President of the United States, and shall remain in effect unless and until modified or revoked by vote of the Association, and until the expiration of the Act.

Stenographic Copies of the Proceedings of The Wire Association will be available at $2.50 per copy.

The Wire Association
17 E. 42nd St. New York, N. Y.

INHIBITORS

By F. P. Spruance,
American Chemical Paint Co., Ambler, Pa.

A discussion of some features, not generally known, of the characteristics of inhibitors. A complete discussion of the subject is not contemplated in this paper. ▼ ▼ ▼

IN the first place, Inhibitors are not new. Patents were issued at least 50 years ago on the use of additions to acid solutions, to prevent acid brittleness, but notwithstanding this early interest in preventing the attack of acids on metals, little success was obtained with Inhibitors as we know them, until 10 or 12 years ago.

I know from actual experience that the manufacturer of Inhibitors required courage in offering these to the Steel Mills, for Inhibitors were looked upon much as "Gold Bricks". Times have changed, in spite of the fact that occasionally a writer will allude to Inhibitors apologetically or with some hesitancy. Inhibitors have found their place in the Pickling Industry, and the technicians realize their merit and their possibilities. The question therefore resolves itself into the selection of the suitable product.

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BEFORE discussing the properties of a suitable Inhibitor, it might be well to summarize those characteristics that are required of any Inhibitor.

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1. An Inhibitor is called upon to save acid, by preventing the pickle bath exhausting itself unnecessarily in dissolving the steel after the scale has been removed. After all, this is the sole purpose of the Inhibitor, in accomplishing which, it is called upon to minimize the absorption of hydrogen, to prevent the spreading of acid-laden fumes into the pickling department, and naturally, to prevent the overpickling of the metal.

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2. AN Inhibitor is usually called upon to save enough acid and metal to pay for itself, although there are times when it is much more important to prevent the attack on the metal than it is to actually reduce the costs of the pickling.

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3. AN Inhibitor, when present in the pickling bath, must not slow the pickling.

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4. IT must not leave objectionable material, or stains, on the pickled surfaces.

These are the important characteristics, although others are occasionally required by the fastidious user.

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MUCH can be said about each of these characteristics, but the important feature of them is, that, with reference to the cost, a satisfactory method of testing must be available.

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TO decide whether or not an Inhibitor slows the pickling action, it is necessary to keep in mind two facts; first, that a good deal of the pickling speed is due to agitation. Agitation can be divided into "general" and "local". General agitation is that due to the convection currents in the heated liquid, or to the agitation from air, if this be occasionally used. Probably the most important source of agitation is the local agitation resulting from the rapid movement of hydrogen along the metal's surface, which serves to siphon fresh acid to the metal. It is obvious that as the hydrogen evolution is decreased, this source of agitation is also decreased.

It can be generally stated, that a good inhibitor does not actually retard the pickling, except in cases of tightly packed sheets, or strands of wire in coils, where the space between the adjacent surfaces is extremely small. In these cases, there is a very slight reduction in the pickling speed, which is due to the reduction in the local agitation just referred to.

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PICKLING speed can be very seriously retarded, and even stopped, by the use of improper materials, notable among which is arsenic, which inexperienced manufacturers have occasionally used. The presence of arsenic in the pickling bath is so serious that but a trace of it, in the acid itself, will have a marked effect in retarding the pickling. I think that this point is now sufficiently understood that nothing further need be said about it, except that the manufacturer should investigate the pickling acid for its arsenic content, in case the pickling time is seriously prolonged.

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WITH reference to objectionable materials—in this lies the secret and skill of the Inhibitor manufacturer. There have been many Inhibitors offered the Pickling Industry which could not be used because residues were left on the pickled surfaces, or stained them. There is no satisfactory way to determine whether an Inhibitor will leave objectionable materials on the surface, in laboratory tests. Production use is the only satisfactory answer. In such investigations, there is a possibility that a great deal of work may be damaged before the deficiency is discovered, which naturally indicates the desirability of selecting materials offered by Companies who have spent years in the development of Inhibitors, rather than to investigate materials offered by Companies with little experience in their manufacture.

THE subject of testing is an important one, for it is usually desirable to conduct laboratory tests to show, as conclusively as possible, the merits of materials that are offered—their strength in comparison with others, so that some idea of the cost can be obtained. Laboratory tests can be very misleading, in that much of the Inhibitor's effectiveness is due to its lasting qualities and to its ability to withstand hot acids and nascent hydrogen. The error most frequently made in laboratory tests is to rely too much upon the percentage loss in weight of a single specimen, pickled in a beaker, with a definite proportion or proportions of the Inhibitor, and under fixed conditions of acid concentration, temperature, etc.

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THERE are certain types of Inhibitors that have a tendency to plate out on the surface, some of them to such an extent that practically no Inhibitor is left in the bath after the first sample is removed. There are other types that have a very strong initial effect which drops rapidly. The control effectiveness of such a product may be markedly reduced in what would correspond to the removal of one or two pins of wire from the pickling tub. There are other types that have a cumulative action, i.e., they become stronger as time goes on. It is obvious that laboratory tests involving the loss in weight of a definite sample will show something, yet they cannot be relied upon unless they simulate actual production conditions.

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LABORATORY tests should be run over a period long enough to correspond with the whole life of the pickling bath, from the time it is charged until it has dissolved enough iron to make further operation uneconomical or unsatisfactory. Such apparatus is being used in our laboratory, with which accurate determinations are made of the various control materials and under various conditions.

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THERE is one other subject that I think is of particular interest to all picklers, viz: that of keeping accurate records of acid and Inhibitor consumption — a daily record of these based on the tonnage pickled, for it must be realized that a good Inhibitor will more than pay for itself in the saving of acid and metal, but to use one in the pickling bath will not drum reason into the head of the pickler, nor will it stop leaks in tubs or prevent the avoidable waste which depend upon man's operation. If daily costs are computed, variations will be brought out, and means to prevent waste and losses can be taken.

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A COPY of the log which is here illustrated can be obtained by addressing the writer. If such records are kept systematically, the information disclosed will make it possible to operate pickling baths at their maximum efficiency. The log can be used to determine, in production, the effect of a change in Inhibitor proportions; it provides a most accurate means of determining the effectiveness of various Inhibitors. In all such tests, care should be taken to use tubs that are free from leakage.

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A WORD on varying the proportions of Inhibitors is in order, for there is a general tendency to use less than the optimum amount. The serious part about this is, that the control effectiveness of a good Inhibitor will fall off rapidly when it is used in extremely small proportions, and conversely, the control effectiveness increases greatly with an increase in proportion. To illustrate this, if the quantity of Inhibitor per gallon of acid in the

(*Please turn to page 342*)

Month ..... 19 ...

PICKLING PERFORMANCE and COSTS

Department ..... Turn ..... Picklers .....

This form is supplied gratis by the American Chemical Paint Company, to the users of its pickle control "RODINE" so that the daily record of acid and RODINE consumption will serve to indicate any changes in the pickling cost.

Where the surface per ton pickled remains nearly constant, an increase in pickling cost may be due to: (1) leaking tubs; (2) discharging too much acid with the spent bath or (3) using too little RODINE.

If the record shows an increase in pounds of acid per ton (#7), the three sources of waste should be investigated. Leaking tubs should be repaired, the spent bath should be analyzed and not discharged till the acid is reduced as low as possible and the RODINE proportion should be kept as high as possible to produce the required surface, for the higher the RODINE proportion, the less acid will be wasted dissolving metal and the lower will be the pickling cost.

"The More RODINE Is Used The Cheaper It Will Be"

DATE	Tons Pickled	Pounds / Pints Rodine Added	Pounds of Acid in Measuring Tank: Start	Added	End	Pounds of Acid Used	Pounds of Acid per Ton Pickled	Pounds / Pints Rodine per Ton Pickled	Final Analysis: Acid	Iron	Cause of Waste If Any
	#1	#2	#3	#4	#5	#6 #3+4-5	#7=6÷1	#8=2÷1			
	Total (1)	Total (2)				Total (6)	T(6)÷T(1)	T(2)÷T(1)			

Rodine Proportion—Total (2) ÷ Total (6) ..... {POUNDS / PINTS

COSTS PER TON FOR THE MONTH

Acid ------- Tot.(6) x Cost of Acid per Lb. ÷ Tot.(1) $.....
Metal (Est.) Tot.(6) x 0.4 x Cost of Metal " " ÷ Tot.(1) $.....
RODINE ----- Tot.(2) x Cost of RODINE (" " / " Pt ÷ Tot.(1) $.....

Form No. 99—1M—7-31 Total cost per ton of Acid, Metal & RODINE ------ $..... Printed in U.S.A.

Sizing And Resizing Tungsten And Diamond Dies For Copper Wire Drawing

(*Continued from page 308*)

wire is drawn into the hole by hand and, being thus drawn to the same size as the worn hole, fills it completely. By adjusting the arms supporting the wire so that it approaches and leaves the die at an angle of approximately 25° with the axis of the hole, the die is shaped at the same time it is resized.

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ON larger sizes, the hole is resized in steps of 0.001". The steel wire used is therefore 0.001" larger than the hole into which it is drawn. The hole is increased in this manner to 0.0005" less than the finished size. At this point, the rotating chuck is tilted so that the axis of the hole in the die is about 45° to the vertical. A steel wire, one half the diameter of the finished hole, is then used. In this manner the hole is shaped as it is brought to the finished size. In the entire resizing of sizes larger than 0.253" the steel wire is maintained with a vertical axis.

The die is then inspected, stamped with size, and placed in stock.

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General

VERY close records on performance of all diamond dies are maintained. Immediately on receipt of a new die a card record is made out noting original size, serial number, manufacturer, date of receipt and purchase price. On this card is kept a record of resizing done, cost of resizing, and poundage of wire drawn per size. When a die is worn out the total poundage is checked against the total cost and the unit cost must meet the curve shown in Fig. 5 on which our standards are based. Our unit costs may appear to be high. This is accounted for by the fact that we limit our wire to ½ of 1% over and under specified size, which means that the drawing life of our dies is somewhat less than would be the case if we allowed the full 1% over and under size permitted by most specifications.

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ALL dies, when returned to stock, are carefully inspected. No die is allowed to remain in the factory for more than 300 hours service. After inspection, satisfactory dies are returned to stock. Unsatisfactory dies are repaired.

INFORMATION SERVICE

To members of the Wire Association an information service is available by which they can obtain data on any subject relating to the industry on which they desire information.

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STRAIGHTENER SPECIALISTS SINCE 1866

The Wire Drawing Die

By Kenneth B. Lewis
Consulting Wire Mill Engineer, Worcester, Mass.

PART IV

A study of die stresses and strains during the drawing operation. Many of the ideas presented here are new and it is quite probable that some of the theories outlined will cause considerable discussion in the industry. The author invites such discussion in an effort to clarify the available data relating to die stresses.--The Editor

THIS seems a good place to sum up what we know or strongly suspect as a result of the facts gathered and theories developed up to this point.

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1. IN order to make metal flow in the die it must be stressed exactly to its yield point. Below that point it will not flow; at that point it flows away from the die and so cannot be further stressed. This is a definite unit stress and probably bears some constant relation to the physical properties which we generally determine by tensile test. We have reason to believe that in the case of most metals the ultimate strength of the wire before the draft is a fair measure of its mean yield point in the die.

2. The total pressure in pounds between the wire and the die is the product of the mean yield point in lbs. per square inch and the contact area in inches.

3. The horizontal component of the total pressure is obtained by multiplying A-a by the mean yield point. This represents that part of die pull which does useful work by deforming the metal.

4. The friction between die and wire is the total pressure in pounds multiplied by the coefficient. Its horizontal component is that product mutiplied by the cosine of the half-angle, which gives us that part of die pull due solely to friction. We think the coefficient of friction for soap-drawn wire lies between .075 and .10.

5. The simplest form of expression for all these stress relations is D. P.=m. y. p. (A-a) (1+ cot cf.).

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WE are entitled to feel a little elated over the development of the basic formula which expresses so simply all the relations of the draft, but it is not enough to develop it; we must find a use for it. There is a double challenge in this formula. We must do a cleaner job of evaluating m. y. p. and cf., and we must then find a way to make profitable adjustments of the factors, trading a small loss against a larger gain. Let us run over the possibilities.

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WE have found that except within fairly close limits we cannot shift the cotangent without changing A-a in the opposite direction. If we decrease the angle to improve die life we must cut down the reduction, thereby giving up our savings. We may steal a little die life by manipulating the shape of the bearing, using the reverse taper in place of the cylinder. The coefficient of friction is of course vulnerable, and highly important. We reduce it when we shift from wet to dry drawing, and in so doing we cut die pull and increase die life, but further reduction is a matter of experiment and slow development. No contemplation of the formula will reduce cf.

KENNETH B. LEWIS
Consulting Wire Mill Engineer, Worcester, Mass.
Member Wire Association

✦ ✦ ✦

THIS drives us back to the mean yield point, a factor we have been avoiding on the ground that it is a fixed property of the metal. In research nothing is sacred, and we are justified in tampering with m.y.p. if we can get our hands on it. What do we know about it? We know that the metal must be stressed to a certain unit value before it will flow, but on careful consideration we find nothing in the law that requires the die to do the stressing. We are, in practise, calling on the die to do two jobs, first to stress the wire to its yield point, then to shape and size it. These are two pretty heavy jobs, and we are requiring a very small tool to do them simultaneously at high speed. Would it not be possible to split up this work, letting the die size and shape metal which has been stressed beforehand?

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THE simplest form of stress is the tensile pull. It seems a little foolish to help wire-drawing by pulling backward on the entering wire but theoretically it would ease the job of the die, so it must be tried. Pass the tail of the undrawn wire over a pulley and hang a weight on it, fasten a spring balance to the front end of the wire and read the die pull.

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HERE are the results of a preliminary test. With the tail free we find that a job on soft basic wire from .025 to .022 takes 21 pounds to draw. We put on a weight of 8 lbs., and the expectation is that we will need 21 to draw and 8 more to lift the weight, total 29. As a matter of fact the spring

balance reads 24. Somewhere we have lost 5 lbs. Increase the weight to 11½ lbs., and instead of 21+11½=32½ we get a pull of 25½; 7 lbs. lost. With a weight of 14 lbs. we get 26½; 8½ lbs. lost. With 17 lbs. on the counterweight our pull is 28; 10 lbs. lost. With 20 lbs. counterweight we get 29 on the spring balance. This can mean only one thing, the draft which ought to take 21 lbs. is taking only 9 lbs. This again can have only one explanation. The only change in conditions we have made is to send the wire into the die under a high stress, and the die has had to stress it only the remaining distance to the yield point.

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ONE thing leaps to the mind at once. Here must be some clue to the actual m. y. p. at which wire will draw. Suppose for example we stress the wire by counterweighting until we have cut the pressure on the die right in half. Then evidently we have stressed it by the counterweight up to half its mean yield point. The back-stressing can be accurately measured, as we have it in pounds, and we have the size of the wire. Then if we double the lbs. per square inch stress on the tail we get the m. y. p. In fact it is not necessary to hit the 50% mark at all. If a certain back stress cuts 10% off the die pressure it must be 10% of the yield point. So we can get check after check as we add each new weight. Without further argument I will present as figure 11 a series of tests and calculated results. This series was made on basic wire annealed at .032, drawn two drafts in soap to .025, and carried to .022 in this test, in a die of tungsten carbide with 10° total angle and 50% bearing. The "effective" cotangent was -18.5. Average m. y. p. is 77,200 lbs. and initial tensile was 74,000, per square inch.

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TO calculate cf. we have the equation $24=.00011\times77000\times(1+\text{cot. cf.})$. This gives us a value of 2.84 for 1+ cot cf, 1.84 for cot cf. and since cotangent is known to be 18.5, cf. is almost exactly .10.

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A SECOND series, a further draft of this same wire to .020, gave m. y. p. as 80,000, and cf. as .10. Both these drafts were made on cold wire. I repeated them on wire still warm from previous drafts, and got values of .097 and .099, a difference which, in view of the crudeness of the appliances, I do not regard as having any particular meaning. Another pair of tests was made on basic carried down from an annealing point of .076 and drawn in these tests from .0243 to .022. The coating was naturally thin, but the cf. values checked .10 in each case, the m. y. p. coming out 90 to 92% of the initial tensile. Further tests both of basic and bessemer gave a steady figure of .10 for coefficient of friction. In all these tests the wire went perfectly dry into the die, depending wholly on the coating established in its first draft after annealing.

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THESE calculations are clearly the most satisfactory we have done, and appear to narrow down our field to a point where we can say that the end we have sought is actually attainable. We started with assumptions which seemed logical, and which placed the coefficient in dry drawing around .10 and the mean yield point near the, initial tensile. We have determined coefficient independent of m. y. p. on the curves of die pull/die angle, and have now determined m. y. p. independent of coefficient by the back-pull method, and we get a cross-check which is immeasurably better than anything previously published. Though the work may have been crudely done, and the conclusions based on rather scanty data, these cross-checks are steady enough to raise the presumption that the values of m. y. p. and cf. are capable of accurate determination.

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WITH regard to the back-pull experiments it is of course entirely possible that developments of commercial interest would follow further study. Die pull cannot be much reduced in this way, in fact under some conditions it will be increased, but the bulk of the stressing can be done outside the die and the pressure on the die drastically reduced. Pressure determines friction and friction determines wear. It should be possible, with low pressures in the die, to make various advantageous adjustments in die angle, bearing length, and draft. To counterweight a running strand would be awkward, though not impossible. Perhaps the most practical road lies in the direction of dividing a normal draft between two dies in the same box, so that the roughing die will stress the wire for the finisher. Much more experiment and calculation need to be done to bring out all the possibilities. I have asked for patents and expect to explore the matter further. So far as this study of die stresses is concerned, however, the value of this technique is clear. We can now determine whether either of our unknown factors is constant, and under what circumstances and in what pattern the other varies. Without burdening these pages further with details I will tell briefly what paths I have explored, what facts seem clear, what theories are supported by the evidence, and where doubt still lies.

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I HAVE worked with a series of tungsten carbide dies with total angles of 6, 8, 10, 12, 14, 16 and 18 degrees, all of the same size, and all of purely conical shape, and a few dies with carefully determined lengths of cylindrical bearing. Drafts have ranged from 10 to

Fig. II

Counter Weight	Unit Stress	Pull Expected	Actual Pull	Lbs. Saved	% Saved	m. y. p.
0	0	.....	24	.....	.....	.....
8	16,300	32	26.75	5.25	21.8	75,000
11	22,500	35	27.5	7.5	31.2	72,000
14	28,500	38	29	9	37.2	77,000
17	35,000	41	30.5	10.5	44	80,000
20	41,000	44	32	12	50	82,000

36% reduction of area. Each set of determinations was made on adjacent short lengths from the same piece of wire, at speeds of about 30 f. p. m. In each case the tests were done in all the dies successively, and in each case with a series of counterweights rising to the breaking strength of the finished wire.

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THE outstanding fact is that mean yield point is a fixed property of the metal, at least within the limits of reasonable drawing practice and apparently considerably outside those limits. The abrupt change in the curves of die pull/die angle is clearly due to a change in the coefficient of friction. This was an unexpected and unwelcome discovery, and it may be safely assumed that I checked and re-checked until no doubt remained in my mind. We are correct in assuming that within limits of reasonable practice the force required to deform metal in the die is constant.

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MEAN yield point is always fairly close to the initial tensile strength. In normal drafting it is very close. Working from a rod or annealed wire, in a light draft the m. y. p. is lower, in a stiff draft about equal, and in an extremely heavy draft somewhat higher than the initial tensile. Working from drawn wire the m. y. p. is a little higher or a little lower, depending on the stage of reduction and the amount of the draft. These variations take a pattern that suggests strongly that m. y. p. is the arithmetical mean of the yield point of the starting wire and 84% of the tensile of the finishing wire. The assumptions we made in dealing with Dr. Brown's data were sound. However light the draft may be this rule seems to hold, and there is therefore no reason to suspect that light drafts work the surface layers of metal and neglect the core.

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WITHIN the limits of current practice the coefficient of friction is very little affected by die angle, and, assuming a uniform degree of die polish and excellence of coating, is a pretty constant factor. Beyond those limits however, for instance in such tests as those of Prof. Thompson, the coefficient begins to vary, falling somewhat in abnormally small and rising considerably in very large angles. It is to be understood that I refer to angles which are abnormally small or large in relation to the draft. In the latter case the value is corrected if there is a cylindrical bearing of proper length. In other words, if we attempt to cut down friction by reducing the contact area, when we pass the limits now recognized as marking out reasonable practice, a rise in the coefficient wipes out our gains.

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PROF. Thompson notes the existence of a critical angle, about 10 to 12° total, at which die pull is at its lowest. I think I detect the existence of a critical contact ratio rather than angle. I believe the curves tend to break at different angles values depending on the amount of draft. I believe the breaks come at about the 4 to 1 contact ratio in dry drawing and at a somewhat smaller ratio, roughly 2¾ to 1 in wet drawing. I hesitate to report this belief as it is not supported by any great volume of data, but as I lack time and facilities to bring the point to issue I pass it on for further consideration by others.

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IN dry drawing with normal drafts and die practice the coefficient of friction ranges .07 to .10, seeming to rise slightly as the coating thins out, but rarely rising over .11 except to mark total failure of the coating. In wet work the coefficient is rarely under .13 and rises to .19. In either case there is a tendency, quite independent of suitability of angles, toward an abnormally high coefficient in very light drafts and abnormally low coefficient in extremely heavy drafts. This is of academic interest only, as it occurs beyond the normal working range of the wire mill.

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WITH regard to my "contact-ratio" speculation, this appears sound so far as my tests have gone. A perfect cone and a combined cone and cylinder of equal area are equivalent. Whether the theory would stand the test of a wider range of conditions and more sensitive equipment I do not know. It must be noted that if the cf. value changes with angle rather than ratio, doubt is thrown on some of the early conclusions in this study. We must consider whether we were correct in assuming that a cylindrical bearing gives rise to as much friction as the same area of cone. It is possible that the straight bearing is not so black as it has been painted. Careful and patient work should make it possible to determine by difference the coefficient of friction in cylindrical bearings. Neither practical men nor research men have been in agreement among themselves on this point, and some accurate observations are at variance with others of seemingly equal accuracy.

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I MAKE no apology for ending this report with such a slim record of accomplishment. It is very pleasant to present a finished piece of research, and the temptation to withhold reports which are not clear and conclusive is very strong, but if we all hold back until we have this job finished I am afraid no reports will be made. No one man is going to bring order out of the chaos which comprises our present stock of knowledge about dies. The die is the key, in fact the only essential tool, of a great industry, yet all the study of a thousand years has brought out scarcely enough of fact or theory to be worth recording. The development of die shapes, die materials, lubricating agents, and other vital factors of the industry are matters of groping, and of testing under conditions of imperfect control. We must dig deep, and we must add one little bit of hard-won fact to another until we can see the whole picture. If it proves that I have stirred up any controversy, called forth any unpublished facts or theories, or if, as I hope, I have suggested in the "back-pull" experiments a means which can help others, more fortunately placed as to time and facilities, to push ahead, I shall feel amply repaid.

'Round the World With the Wire Industry

IWECO Price Revisions

THE IWECO has revised some of the prices. The quotations for Venezuela, Colombia, Peru, Ecuador and Chile have been slightly advanced (by s 1/6-2/3), the quotations for North Europe and the near East slightly reduced.

British India continues to be a strong buyer, with the demand considerably above last year, particularly for wire ropes and strand wire and barbed wire. China bought this year approximately 2 times more wire netting and barbed wire than last year, whereas business with the Dutch Indies is very dull. The Near East and the Irak is buying more than last year, particularly wire nails and baling wire. South Africa has greatly advanced purchases of wire netting and fencing wire, whereas the African Colonies buy little. Latin America is a dull market, except Colombia, Brazil and Peru, these 3 countries buying much more than last year.

The Swedish wood screw makers have agreed not to undersell the British and the continental wood screw manufacturers.

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German Wire Products Exports Decline

THERE has been a sharp decline in Germany's exports of wire products this year. The first half year figures are as follows (in parenthesis first half of 1932) wire rods 30,678 tons (14,472 tons), bright wire 29.928 tons (33,526 tons), galvanized, nickelled, tinned, coppered and similar wire 36,417 tons, (42,612 tons), wire ropes and strand wire 3,882 tons (4,344 tons), barbed wire 14,613 tons (18,149 tons), wire netting, square and hexagonal, 6,879 tons (9,311 tons), wire nails 10,930 tons (18,847 tons), and miccellaneous small wire products 2,-734 tons (2,671 tons). Exports of non-ferrous wire products also shown a sharp drop: wire from aluminum 10.3 tons (18.6 tons), lead wire 58 tons (57 tons), zinc 29 tons (58 tons), nickel 57 tons (66 tons), copper 3,928 tons (5,445 tons), brass and bronze wire 1.390 tons (1.347 tons) and ropes and strand from copper and brass wire 665 tons (1,173 tons). The decline in exports to the United States was rather heavy. There was an increase in exports of wire rods from 487 tons to 1,838 tons and of wire ropes and strand from 547 tons to 598 tons, but exports of barbed wire declined from 6,104 tons to 3,165 tons; of wire netting from 2,451 tons only 800 tons and of wire nails from 5.055 tons to only 1.955 tons. The export business with the United States showed a slightly rising tendency during the months of June, July and August and figures are still rising.

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German Wire Industry Organizes

THE organization of the German wire industry has now been completed. As reported already the outsiders, 107 in number, have established a cartel, which orginally was meant as an instrument of resistance against the wire cartel, but which has now come to terms with the wire cartel. All questions concerning prices, raw material buying, distribution of domestic markets have been settled. The second German cartel, which includes small manufacturers almost exclusively will not sell for export. Only the Drahtverband Dusseldorf will sell for export. The second German cartel (Vereinigung der freien Draht and Drahtstifte-fabrikanten) will be at Hagen i. W.

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Interesting British Cable-Laying Feat

AN interesting cable-laying job was recently performed by a small British ship which put out from Southsea carrying over three miles of telephone cable. In five hours it laid a new Post Office submarine line to Nettlestone Point, Isle of Wight, where it was joined with the land cable to Ryde.

The provision of the new cable will allow telephone circuits between London and the Isle of Wight to be worked on what is known as "zero loss," which means that volume of speech received on the island will be equal to that which left London.

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LAYING this new cable was a comparatively simple operation, but even with the shortest submarine cable some difficult problems are solved. For example, a course has to be selected which is as free as possible from interference by ships' anchors and trawls. When it has been marked on the chart, buoys are placed at intervals indicating the exact route for the cable to follow. The actual day and time of laying is determined by the tide, the high spring tides making it easier for the cable, which is carried entirely on the ship, to be pulled ashore by rope and connected with the land cable. As soon as the shore end has been landed the cable ship steams off, paying out cable as she moves; great navigating skill is required, for the ship is generally travelling across the tide, and is hampered by the cable itself.

The strain on the cable must be carefully watched, for it must lie flat on the sea bottom, but with sufficient slackness to allow it to be lifted for repairs if necessary. The new Isle of Wight cable contains 38 pairs of copper conductors, which are encased in a double sheath of lead. In turn the sheath is covered with thick armoring wires of a special iron not likely to corrode. The outer covering consists of a kind of tarred yarn. The completed cable weighs about 30 tons per nautical mile.

'Round the World With the Wire Industry

AN official of the Post Office Engineering Department states that Post Office cables are made to last 50 or 60 years, if not interfered with. Parts of the first North Sea telegraph cable to Germany, laid in 1861, are still in existence.

The testing of the cable for faults has been brought to a high degree of efficiency by the Post Office, which has apparatus which makes it possible to locate a fault within a few yards. A carefully recorded chart of each cable is kept, showing its exact position. When the fault is approximately located a grapnel is dropped and drawn along the sea bottom. There is another apparatus for judging strain, so that the engineers know whether the grapnel is pulling on the rock or on the cable.

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THE British Post Office has over 50 major telephone and telegraph cables in the North Sea, the English Channel, and the Irish Sea, and over 200 shorter lines to the various islands round the coast. There are six to Germany, six to Holland, seven to Belgium, 16 to France, and 15 to Ireland. Two P. O. cable ships are constantly employed, and, in addition, the cable contractors' vessels are often used for some of the long-distance jobs.

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THE work of experiment and improvement never ends. Recently the Dutch telephone service has been greatly augmented by a system of linking up of separate pairs of wires, so that where eight conversations could be carried out simultaneously twenty are now possible, without the laying of new cables. This is due to the introduction of what is practically a form of radio, one conversation being superimposed on another without interference.

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The Irish Market For Wire

THE suggestion has been made in Germany that the time was ripe for the German wire industry to take advantage of the Irish boycott of England goods to strengthen their own position. Attention is called however to the fact that Ireland has never been a large consumer of English wire products. Wire rope has been her largest item, followed by a telegraph and telephone wire, then square mesh fabrics. Of Ireland's requirements in barbed wire, round fence wire, and wire netting, England has covered only 5%, while her very respectable requirements in nails have been filled outside Great Britain. The entire importation from England in 1931 was 11 tons, all of which went to Ulster.

The revaluation of the pound sterling has not changed the situation. England continues to ship practically no wire products to Ireland. Sweden has recently made heavy shipments of nails, but rumors that the French were working the Irish market intensively do not seem to be well founded.

Conditions in Ireland are none too satisfactory. The farmers are buying scarcely anything. The only bright spot is hexagon mesh, for which orders have been coming in nicely, especially for small mesh and light gauges. Nail inquiries are chiefly for small tacks, and in the barbed wire field the Swiss have got a foothold with single-wire products. Improvement is expected in 1933 as stocks are very low.

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British Goodrich To Control Big Cable-Making Rival

THE chief feature of the scheme just announced in London for the reorganization of the India Rubber, Gutta Percha & Telegraph Works Co., which during the past few years has fallen upon very lean times, is that the British Goodrich Rubber Co., is prepared to arrange for the provision of £100,000 ($500,000) of new capital in ordinary shares ranking behind the existing share capital as reduced and altered under the scheme. The company is at present in debt, and although there has recently been a notable improvement, the current year's operations are likely to show a loss. But in view of the attractive offer made by British Goodrich the board, instead of deferring reorganization until profits are being earned once more, proposes to proceed with it at once.

The present ordinary shares, after being reduced from £1 to one-fifth of that sum, will be converted into preferred ordinary shares entitled to a non-cumulative dividend of 6 per cent and to 50 per cent of the surplus profits. Special voting rights will give British Goodrich control of the concern. These shares will carry a non-cumulative dividend of 6 per cent and the remaining half of the surplus profits. Trust companies which are large holders of the existing preference and ordinary shares have approved the scheme, and it is expected that the shareholders will do likewise. The firms have been competitors in the cable-making industry.

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British Allow Duty-Free Import of Wire Machinery

ON the recommendation of the Import Duties Advisory Committee the British Treasury has approved the revision of the classes of machinery which may, in certain circumstances, be imported into the United Kingdom free of duty. The revised list includes wire working and winding machinery and testing machinery.

It is explained that this machinery is not freed generally from duty. Licenses are issued by the Committee only in respect of particular consignments, where it is shown that the machinery is, for the time being, not procurable in the United Kingdom.

Exports and Imports of Wire

Exports of iron and steel wire products in July, 1933 and July, 1932

(In gross tons)

	July 1933	June 1933	July 1932
Wire rods	1,038	1,312	105
Hoops, bands and strip steel	1,321	2,134	1,594
Plain black or galvanized iron or steel wire	1,526	1,694	448
Barbed wire and woven wire fencing	2,390	2,822	1,169
Woven wire screen cloth	77	76	67
Wire rope	203	157	133
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	132	264	159
Wire Nails	1,026	1,141	935
Tacks	26	23	31
Other nails, including staples	245	322	170
Bolts, machine screws, nuts, rivets, and washers	214	263	250
Total, these 11 classifications	8,198	10,208	5,061

Imports of iron and steel wire and wire products into the United States

(In gross tons)

Concrete reinforcement bars	122	313	2,027
Hollow bars and drill steel	44	90	92
Merchant steel bars	1,605	1,844	2,396
Wire rods	1,753	1,431	267
Barbed wire	550	368	1,254
Round iron and steel wire	....	....	3
Telephone and Telegraph wire	388	169	156
Flat wire and strip steel	90	102	567
Wire rope and strand	115	125	70
Other wire	126	105	157
Hoops and bands	1,842	1,955	4,188
Nails, tacks and staples	339	375	1,043
Bolts, nuts and rivets	22	16	17
Total, these 13 classifications	6,996	6,893	12,237

Exports of Insulated Wire and Cable

JUNE, 1933

	Lbs.	Value
Insulated iron or steel wire and cable	24,958	$ 2,263
Rubber covered wire	179,640	30,688
Insulated copper weatherproof wire	58,170	8,145
Wire and cable telephone cable	790	179
Other insulated copper wire	79,160	17,857
Nickel-Chrome Electric Resistance Wire	19,956	24,062
Total, these 6 classifications	362,674	$83,194

JULY exports were 14,270 tons smaller than were those in June, thus interrupting for the second consecutive month the climb in this trade which had extended over a six month period. The July decline was, as was also true of June, the result of a drop in the exports of the single item "scrap", the shipments of which were smaller by 17,279 tons. The principal gains were those of 1078 tons in heavy rails, 998 tons in skelp and 741 tons in welded galvanized steel pipe. There were no losses of any great extent recorded in the trade with the exception of that already mentioned in scrap.

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THE countries of the Far East continued to be in July, as in the elapsed seven months of the year, the best market for American iron and steel. This area received 59.5 percent of total shipments during the month, while over the seven months it purchased 63.2 percent of the total trade. North and Central America and the West Indies, the second largest market area, took 23.7 percent of the month's trade (15.3 percent of the cumulative total), while South American countries with 8.5 percent (5.8 percent) were third, and Europe with 7.3 percent (15.4 percent) was fourth. African countries took 724 tons during the month and 2,717 tons during the first seven months of the year.

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THE largest individual market for the month was Japan whose purchases of 44,002 tons included 39,843 tons of scrap, and 982 tons of wire rods. Canada, with total purchases of 13,199 tons, took 3,568 tons of skelp, 1,864 tons of scrap and 1,163 tons of hoops and bands, 1,140 tons of cold rolled strip steel and 1,026 tons of steel bars. The Phillippine Islands was July's third largest market with total receipts of 4,895 tons, which included 562 tons of wire nails. Of the 2,799 tons shipped to Mexico, 276 tons were barbed wire, and 236 tons were hoops and bands.

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IMPORTS of iron and steel products continued to rise rapidly, increasing from the 34,368 tons imported during June to 52,805 tons in July.

✦ ✦ ✦

DESPITE the increased receipts recorded by the import trade during the past few months, the cumulative total for the seven elapsed months of 1933 remains lower than for the same period of 1932 by 22,208 tons. Large gains for this period have been recorded in the purchases of such items as pig iron, ferro-manganese and scrap, these, however, having been more than counterbalanced by losses in the receipts of concrete reinforcement bars, merchant steel bars, sheets, skelp and sawplate, structural shapes, barbed wire and hoops and bands.

✦ ✦ ✦

SHIPMENTS of scrap (13,391 tons), ferro-manganese (4,422 tons) and of rails and fastenings (2,554 tons) was responsible for Canada's premier rank in the July import trade—her total of 20,648 tons being made up principally by these three items. The Netherlands with total shipments of 13,514 tons, of which 13,471 tons consisted of pig iron, was the second largest source of our imports, while Belgium with 4,356 tons (1,384 tons of hoops and bands, 1083 tons of structural shapes and 925 tons of merchant steel bars) was third, India with 3,931 tons (all of which was pig-iron) was fourth, germany with 3,348 tons (753 tons of shapes and 361 tons of merchant steel bars) fifht, and Norway, 3,056 tons (2,551 tons of ferro-

(*Please turn to page 347*)

A Review of Recent Wire Patents

No. 1,916,512, FIXED SIZE SPRING UNIT AND METHOD OF FORMING SAME, Patented July 4, 1933, by Roy S. Jones, Anderson, Ind., assignor to Barber Manufacturing Company, Anderson, Ind., a Corporation.

A feature of the invention is present in the mashing of the connecting helix and simultaneously with the mashing, embedding the connecting helix into corrugations simultaneously formed in the end coil of the end coil spring.

✦ ✦ ✦

No. 1,916,602, ACID RESISTING ALLOY, Patented July 4, 1933, by William J. Braddock, Wheeling, W. Va.

Proportions in this alloy which is provided particularly for welding and has also corrosion resisting properties, consist of copper 90 to 94%, aluminum 3 to 5% and nickel, 3 to 5%, the proportion of aluminum to nickel to be the same in any event.

✦ ✦ ✦

No. 1,916,989, WIRE, Patented July 4, 1933, by Harold K. Rader, Port Huron, Mich., assignor to Mueller Brass Co., Port Huron, Mich., a Corporation of Michigan.

This is a combination anchoring and soldering or sealing wire having a certain degree of stiffness, so it may be used as an anchoring or locking piece, but carries a solder for sealing purposes as a core and extending to the periphery of the wire.

✦ ✦ ✦

No. 1,917,022, ELECTROCHEMICAL PROCESS FOR CLEANING METAL, Patented July 4, 1933, by Thomas E. Dunn, Bridgeport, Conn., assignor to The Bullard Company, a Corporation of Connecticut.

This process is provided to remove non-magnetic foreign matter, particularly grease, wax, paint and carbon smuts from metal surfaces and the process consists of subjecting the parts as anodes to electrolytic action in an alkaline electrolyte containing metallic ions of the lead group which combine with the foreign matter.

✦ ✦ ✦

No. 1,917,219, WIRE DRAWING MACHINE, Patented July 11, 1933, by Paul W. Dillon, Sterling, Ill., assignor to Northwestern Barbwire Co., Sterling, Ill., a Corporation of Illinois.

In this wire drawing machine, means are provided for automatically throwing out the clutch and stopping the machine if a link or loop is formed in the wire before it reaches the first die. Means are also provided for driving the machine at the rear end thereof and for positioning the winding reel in a horizontal position.

✦ ✦ ✦

No. 1,917,486, SPRING, Patented July 11, 1933, by William Beck, New York, N. Y.

Particularly, this spring is provided for driving the generator of flashlights. The spring comprises a single length of wire having a number of duplicating units, each comprising two reversely wound spiral sections.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 1,917,991, VACUUM TUBE FILAMENT STRUCTURE, Patented July 11, 1933, by Frederick S. McCullough, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, a Corporation of Pennsylvania.

The cathode of the tube is a core of wire with a fragile oxide-coated metallic strip specially wound thereabout, with the ends of the strip welded.

✦ ✦ ✦

No. 1,913,237, WIRE DRAWING APPARATUS, Patented July 18, 1933, by John L. Alden, La Grange, Ill., assignor, by mesne assignments, to Western Electric Co. Inc., New York, N. Y., a Corporation of New York.

More particularly the invention relates to capstans having a groove formed thereon for drawing the wire thru the last or finishing die at a constant speed. This groove may be formed by leaving an end face plain and attaching thereto a plate having a beveled edge so as to provide a triangular groove.

✦ ✦ ✦

No. 1,918,344, APPARATUS FOR INSULATING WIRE, Patented July 18, 1933, by Edward A. Mau, Arlington, N. J., and Orrin F. Hutchinson, New Haven, Conn., assignors to Rockbestos Products Corporation, New Haven, Conn.

This device is adapted to apply the insulating covering without fatiguing the wire, as well as polishing the covering and providing for an even coating.

✦ ✦ ✦

No. 1,918,552, WIRING MACHINE, Patented July 18, 1933, by Joseph P. Mingle, Muncie, Ind., assignor to Ball Brothers Company, Muncie, Ind., a Corporation of Indiana.

This wiring machine is particularly provided for fastening wire collars to the neck of jars and then applying a twisting to the ends of the collars.

✦ ✦ ✦

No. 1,918,761, RESILIENT BOTTOM FOR UPHOLSTERED FURNITURE, Patented July 18, 1933, by Jacob Kronheim, Cleveland, Ohio.

The assembly includes a number of wire springs, connecting the frame and a flexible base member, the springs having narrow curved brackets of thin resilient metal at one end for attachment to the frame and permitting the springs to move about.

✦ ✦ ✦

No. 1,918,936, FLATTENING DEVICE, Patented July 18, 1933, by George F. Shearman, Chicago, Ill., assignor of one-half to John D. Newton, Chicago, Illinois.

More particularly, the invention relates to the manufacture of nails, tacks, etc., such as are adapted specifically for crate construction. The driving point has two flat tapered faces with their smallest ends merging into the point and additional flat tapered faces extending in reverse directions from the first faces to a portion of the circumference of the nail and merging into elongate cutting edges.

✦ ✦ ✦

No. 1,919,038, UPHOLSTERY PIN, Patented July 18, 1933, by Daniel I. Reiter, New York, New York.

This is an upholstering pin composed of a single length of wire having a main pin and a secondary pin adapted to be arranged in any desired angle and at any desired distance in relation to the head.

✦ ✦ ✦

No. 1,919,509, MULTIPLE LAY CABLE, Patented July 25, 1933, by Josef Grobl, Solln near Munich, Germany, assignor to the Firm Bayernwerk Aktiengesellschaft, Munich, Germany.

The inventor aims to eliminate torsional movement in cables and disposes the layers on a wire core in such a way that in the outermost layer the pitch of the individual wires is greater than that of the wires of the inner layer, whereby the diameter of the individual turns of the outermost layer is smaller.

✦ ✦ ✦

No. 1,919,994, COIL WINDING MACHINE, Patented July 25, 1933, by Jacob J. Vienneau, Pittsfield, Mass., assignor to General Electric Company, a Corporation of New York.

In this invention, means are provided for winding layers of insulation between the layers of wire forming the coil in such a manner that relatively larger amounts of the insulation are disposed between the end turns of successive layers.

✦ ✦ ✦

No. 1,920,180, ELECTRIC CABLE, Patented August 1, 1933 by Alfred P. S. Bellis, Trenton, N. J., assignor to John A. Roebling's Sons Company, Trenton, N. J., a Corporation of New Jersey.

This cable is adapted for voltages in excess of 7,500 volts, and yet employing two concentric multiple wire conductor assemblies. A special wall of insulation is provided between the two assemblies having a supporting covering for the layer of wires forming the outer conductor, this being tapes of cotton over paper insulation.

✦ ✦ ✦

No. 1,920,207, STRAND WORKING APPARATUS, Patented August 1, 1933 by Edwin J. McIlvried, Cleveland, Ohio, assignor, by mesne assignments, to Western Electric Company, Incorporated, New York, N. Y., a Corporation of New York.

Particularly, the apparatus is provided for drawing fine wires. In the assembly, the take-up spool is stopped before bringing the capstan to a full stop and the momentum of the spool is eliminated, so breakage of wire between the two is minimized.

The Wire Association

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W. D. Pierson, Secretary, Waterbury Farrel F'dry & Mach., Co., Waterbury, Conn.

J. C. Ward, Jr., General Works, Mgr., General Cable Corp., White Plains, N. Y.

ANNUAL MEETING AND CONVENTION

Detroit, Mich., October 2, 3, 4, 5, 1933

✦ ✦ ✦

PROGRAM

Monday, October 2, 1933, at Hotel Book-Cadillac

A. M. and P. M. -- Registration--"Get Together"

P. M. -- Informal meeting at headquarters of The Wire Association

These meetings will be held every night from 8 to 11 o'clock during the convention.

The Technical Sessions

TUESDAY, WEDNESDAY AND THURSDAY, OCTOBER 3-4-5, 1933

Program Committee

Ralph K. Clifford, Gen'l Supt., Continental Steel Corp., Kokomo, Ind., Chairman

E. W. Clark, Managing Engineer, Wire Dept., General Electric Co., Schenectady, N. Y.

W. D. Pierson, Sec'y. Waterbury Farrell Fdry. & Machine Co., Waterbury, Conn.

Kenneth B. Lewis, Wire Mill Engineer, Worcester, Mass.

R. E. Brown, Secretary, The Wire Association, 17 E. 42nd St., New York, N. Y.

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THESE SESSIONS.

Stenographic Copies of the Discussions Will Be Available at $2.50 Per Copy.

At the technical sessions to be held Tuesday, Wednesday and Thursday, the papers will be brief. It is intended that the time shall be spent in open discussion and exchange of experience in matters of general interest to wire mill operating men.

The discussions will cover, so far as time permits and in addition to matters arising naturally out of the papers read, a number of topics which have been suggested by members. These topics are listed in this program.

Tuesday, October 3, 1933

KENNETH B. LEWIS

Consulting Wire Mill Engineer, Worcester, Mass.

Chairman of Meeting

Morning Session—at Hotel Book-Cadillac at 9:30 A. M.

TOPICS—DIES—LUBRICANTS, INHIBITORS, LIME, ETC.

Paper—"SIZING AND RESIZING CARBIDE AND DIAMOND DIES FOR COPPER WIRE DRAWING"

By J. J. Kehoe, Designing Engineer, and F. D. Ruhl, Process Engineering Department, General Electric Co., Schenectady, N. Y.

Paper—"INHIBITORS"

By F. P. Spruance, Sales Manager, American Chemical Paint Co., Ambler, Penna.

QUESTIONS FOR DISCUSSION

1. What might the opinion be this year in connection with the cooling of tungsten carbide dies for drawing vs the use of dies not cooled, and what style of water cooled holder has been found the most economical and desirable?
2. What causes tungsten carbide dies to check and flake on the wearing surface—not through the entire nib?
3. Are any definite figures available as to die costs per 1000 lb. of wire drawn?
4. Does the use of Inhibitors influence sulling or the use of pressure water?
5. In cleaning is the high pressure hose of importance in rinsing?
6. Is quick cleaning in hot strong acid better than slow cleaning for patented stock?
7. Can soap be applied out of solution and baked on?
8. Does cold lime make a brighter wire?
9. Is sulling actually necessary? Some claim not but most wire men say this is positively necessary.

BAKING—ANNEALING AND WELDING

10. Can steel rods be overbaked? For example, if dry in 3 hours and left in bakers for 6 or 8 hours, would any damage be done, and what should be the maximum temperature of bakers, both for Low and High Carbon steel?
11. What is the most satisfactory style of furnace for producing extra bright annealed wire, and what subsequent treatment is necessary to prevent its oxidation?
12. To what extent has it proven beneficial to weld rods preparatory to drawing? Is this done at the drawing machines or both in cleaning and drawing departments? What are the sizes and weights of coils of rods universally desired?
13. In galvanizing, what experience has there been with welding back of annealer? What effect on life of wipes—amount of scrap? What troubles?

Wednesday, October 4, 1933

RALPH K. CLIFFORD

General Supt., Continental Steel Co., Kokomo, Ind.

Chairman of Meeting

Morning Session—9:30 A. M. at Hotel Book-Cadillac

TOPIC—EFFECT OF THE NRA ON PRODUCTION COSTS AND OPERATING SCHEDULES.

Paper—"TEAMWORK IN INDUSTRY"

By 1st Lieut. Frank W. Bullock, U. S. A.—Research Student at Harvard School of Business Administration.

QUESTIONS FOR DISCUSSION

WIRE DRAWING

14. The drawing of High and Low Carbon wire with continuous machines vs double deck moto-blocs.
15. Which is considered the best practice—to draw wire (a total of 80% reduction) by taking 5 or 7 drafts, and which method produces the lowest tensile and highest torsions?
16. What methods are there for giving true lay to wire as it is being wound up on horizontal blocks on a tinning or galvanizing frame without the use of forming rolls, and what trouble are our members experiencing with the necking down in size of wire through the use of such devices and how can it be avoided?
17. If rope wire is artificially cooled on blocks does resting between drafts do any good?
18. Are electric resistance pointers any good on low carbon wire?

Wednesday, October 4, 1933

ANNUAL MEETING OF THE WIRE ASSOCIATION

2:30 P. M. at Hotel Book-Cadillac

Presiding—John Mordica, Supt. Rod & Wire Mills, Bethlehem Steel Co., Sparrows Point, Md., President of the Wire Association.

General Business of the Association:—
Financial Report
Plans for 1934 Meeting
Reports of Committees
New Business

✦ ✦ ✦

Thursday, October 5, 1933

Non-Ferrous Session

W. D. PIERSON
Secretary, Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Chairman of Meeting

Morning Session—9:30 A. M. at Hotel Book-Cadillac

TOPIC—COPPER AND COPPER ALLOY WIRE

Paper—"COPPER ALLOY WIRE"

By James T. Kemp, Service Engineer, American Brass Co., Waterbury, Conn.

QUESTIONS FOR DISCUSSION

19. **In the single hole drawing of copper rods why do some mills use soap powder and others tallow or grease for lubricating the dies on the first draft, and what is the difference in the results obtained?**
20. **Is it true that 1/4" rolled rod is more satisfactory for drawing into fine wire (say No. 35 B & S and smaller) than a 5/16" rod?**
21. **Are there any developments in either rod rolling or wire drawing machinery that would make it more economical or otherwise desirable to start drawing with a 7" Rod instead of the heretofore accepted standard of 1/4" or 5/16" Rod? This has reference to ordinary copper wire, not such wire as is drawn from large rods for the purpose of obtaining special tensile strength, elongation, etc.**
22. **If they use hard drawn wire in the manufacture of screen cloth, why do the makers object to such wire being supplied to them drawn on spools, and would it be possible to standardize on the spool sizes used in the weaving process?**
23. **Is it customary to bake the wire used for enamelled wire before applying the enamel, and if so, why is it considered necessary?**
24. **Is any information or any formula available as to the power required to draw rectangular or square stock through a die? Does the power consumption depend entirely on the area reduction, or does the surface in contact with the die also have to be taken into consideration?**
25. **What combination of wire sizes, drawing speeds and coil weights are considered practical when drawing wire on a block?**
26. **Since the last meeting have any new facts come to light regarding drawing speeds in relation to die costs, particularly with regard to fine work?**

✦ ✦ ✦

MAKE YOUR PLANS NOW TO ATTEND THESE MEETINGS!

Make your Reservation at the Hotel Book-Cadillac and
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RICHARD E. BROWN, Secretary
THE WIRE ASSOCIATION, 17 EAST 42ND STREET, NEW YORK, N. Y.

Big London Cable System Being Diverted

THE British Post Office engineers are at present engaged on the work of diverting and replacing about 100 cables which carry something like 70,000 telephone wires. The work has been made necessary by the improvements being made by the Central London Railway at Chancery Lane station, where it is constructing a new booking office.

One of the chief engineers of the Post Office states that he will have to shift a great deal of the main London cable plant. His men expect to divert and replace the cables without interfering with a single telephone call. Alternative cables will be supplied over another route while the replacement is in progress. The work will take nearly a year to complete. It will mean the disappearance of the old parcels tube, which was constructed over 70 years ago. The tube was built for the purpose of shooting parcels by means of compressed air from the General Post Office to Easton Station, several miles distant. It lay derelict for some years, and the Post Office then took it over to house the present telephone cable system. The railroad improvements made it necessary to close the tube, and a new subway has been provided.

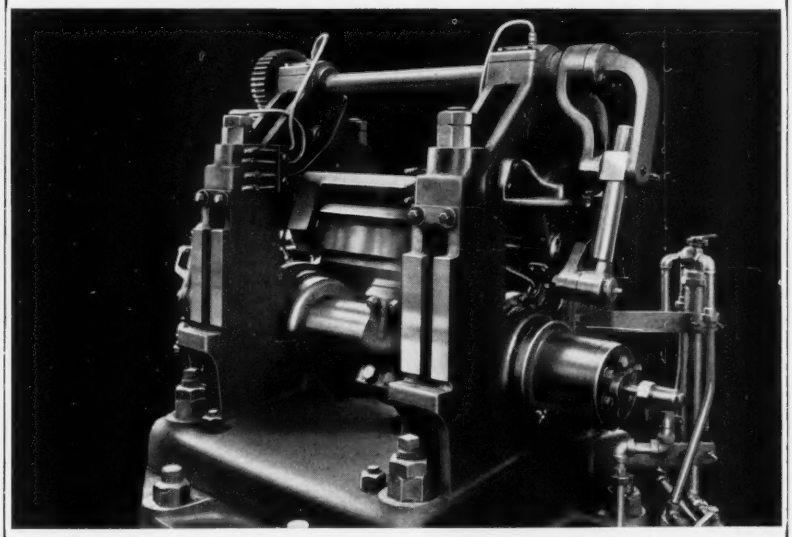
✦ ✦ ✦

British Cable Firms Subsidiary Prospering

INTERESTING particulars have just been issued in London of the Enfield Rolling Mills, which firm is closely associated with the Enfield Cable Works. The new money required by the firm during the coming year is to be provided by the most important stockholders, the most important being the Enfield Cable Co. Until its conversion to a public company at the end of 1932, the Rolling Mills company. Its main business was Co., was a subsidiary of the cable to supply the parent company with copper rod, but it has since con-

(*Please turn to page 342*)

FLYING SHEAR *by LEWIS*



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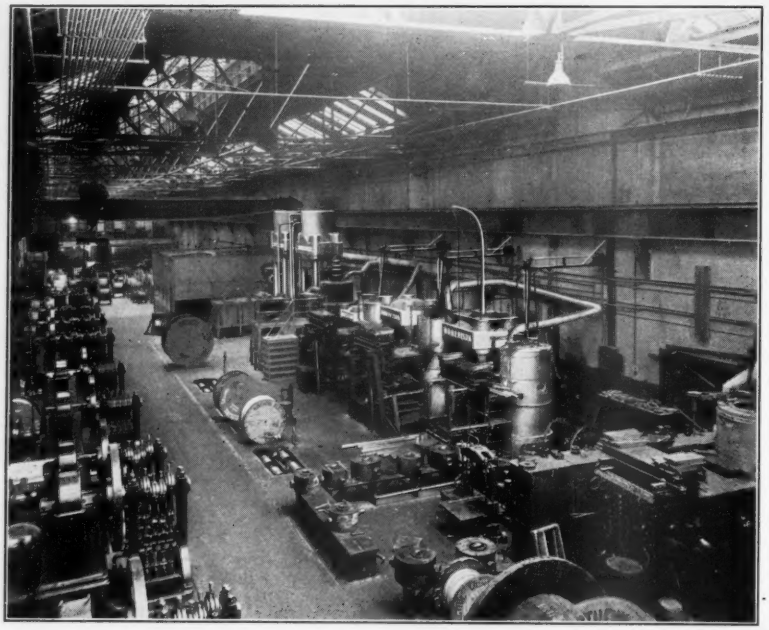

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Inhibitors

(*Continued from page 329*)

solution, is doubled, the control effectiveness may be increased not twice, but four, six, or even eight times. As a result of the rapid reduction in control effectiveness of small proportions, it is obviously wrong to try to use very small quantities of a strong, expensive Inhibitor, to equal the cost of relatively large amounts of a cheap, but weak, Inhibitor. In so doing, the economy that would be derived from using standard quantities of the good Inhibitor will be lost.

✦ ✦ ✦

Copper Alloy Wire

(*Continued from page 317*)

and Electrolytic Copper. Each is suitable for some type of welding, and each is in regular use.

✦ ✦ ✦

IN reviewing the field of wire products based on copper, we have a wide variety of alloys, the more important only have been touched upon. Neglecting copper itself, used so generally for electrical conductors, there are the alloys with Cadmium, possessing fair strength and good conductivity: the alloys of tin, higher in strength but lower in conductivities: the alloys with zinc, with a wide range of strength but generally too low in conductivity to be used in electrical work: the alloys with nickel: with aluminum and tin: with manganese and silicon: the alloys with beryllium that are hardened with heat treatment and the more complex low copper group used in wire for convenience only. All the true wires have good ductility with a wide range of available strengths. There is, in fact, a copper or alloy wire available for almost every engineering need.

✦ ✦ ✦

British Cable Firm

(*Continued from page 341*)

siderably expanded its activities, taking in the production of sectional and strip copper, and, recently, to the manufacture of high quality metal sheets and apparatus for brewing, food preserving, chemical, and other industries. The supply of these new products will be possible within the next three months.

A Review of Recent Wire Patents

(*Also see page 337*)

No. 1,921,606, MULTICORE HIGH TENSION CABLE, Patented August 8, 1933, by Carl Cremer, Copenick-Wendenschloss, near Berlin, Germany.

The inventor aims to provide a moisture proof multi-wire cable. In the construction thereof, a number of single core lead-covered cables are twisted with an equal number of round soft lead tubes in a twisting machine, the tubes being deformed in the machine to a triangular cross section, equal to the space and shape between any two of the single core cables and the circle thereabout.

✦ ✦ ✦

No. 1,921,654, MANUFACTURE OF BOLTS, SCREWS AND THE LIKE, Patented August 8, 1933 by Louis S. Burbank, deceased, late of Worcester, Mass.; by Davis E. Burbank, administrator, Worcester, Mass., assignor by mesne assignments to The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn., a Corporation of Connecticut.

It is claimed this machine will progressively and continually form bolts and the like by the provision of punches and dies adapted for extrusion and upsetting of the metal.

✦ ✦ ✦

No. 1,921.655, MACHINE FOR FINISHING THE HEADS OF BOLTS, SCREWS, AND THE LIKE, Patented August 8, 1933 by Louis S. Burbank, deceased, late of Worcester, Mass.; by Davis E. Burbank, administrator, Worcester, Mass., assignor by mesne assignments to The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn., a Corporation of Connecticut.

Die and punch elements are provided to trim the bolt heads in one operative stroke of the machine.

✦ ✦ ✦

No. 1,921,800, APPARATUS FOR MAKING WIRE, Patented August 8, 1933 by Clarence P. Berolzheimer, Chicago Heights, Ill., and Karl H. Andren, Milwaukee, Wis.; said Andrew assignor to said Berolzheimer.

Particularly, the invention covers the application of metal tabs in fixed and spaced intervals along wire in order to protect manufacturers thereof from unscrupulous imitators. A rotor member is provided which affixes the tabs along the advancing wire.

✦ ✦ ✦

No. 1,922,269, ZIGZAG MESH FABRIC, Patented August 15, 1933 by Theodore H. Wickwire, Jr., New York, N. Y., assignor to Welded Fabrics Corporation, New York, N. Y., a Corporation of New York.

This wire fabric is unwoven and consists of a set of continuous laterally spaced strands, recurrently laid or folded inwardly from the sheet edges of the fabric, with each succeeding lay or fold on the same face of and overlapping about one-half of the area of the preceding lay or fold. The fabric is made self-sustaining by the strands having the meeting surfaces directly secured together, by welding or otherwise.

✦ ✦ ✦

No. 1,922, 271, APPARATUS FOR FORMATION AND WELDING OF CROSSED WIRE PRODUCTS, Patented August 15, 1933 by Raymond J. Southwell and Theodore H. Wickwire, Jr., New York, N. Y., assignors to Welded Fabrics Corporation, New York, N. Y., a Corporation of New York.

This patent covers a machine for forming and welding the wire fabric particularly described in patent No. 1,922,-269.

✦ ✦ ✦

No. 1,922,497, METHOD AND MACHINE FOR MAKING WIRE-DRAWING DIES, ETC., Patented August 15, 1933 by John E. Peterson and Emil A. Van Beke, North Bergen, N. J., assignors to Eisler Electric Corporation, Newark, N. J., a Corporation of Delaware.

The patent claims cover only the apparatus for making wire drawing dies, and do not cover a method. Particularly, the invention lies in the mechanism for drilling the dies.

✦ ✦ ✦

No. 1,922,907, CABLE, Patented August 15, 1933 by Philip H. Chase, Bala-Cynwyd, Pennsylvania.

To equalize hydro-static pressure within the sheath of the cable, the inventor provides a separate, impermeable, liquid-carrying metallic tube within the sheath, this tube being thin enough to expand and contract. A hydrostatic compensating reservoir is provided, connected to the tube. The liquid contained within the tube is preferably thin oil.

(*Please turn to page 348*)

Wooden Spools, Reels and Bobbins

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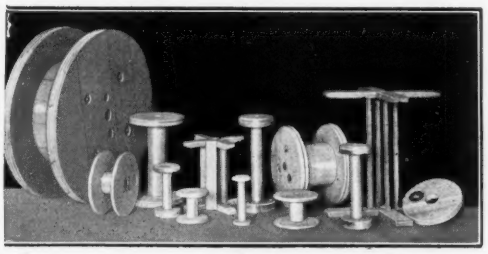

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Move to Adjust Employes' Debt Tangles

"CONNECTICUT INDUSTRY" reports that believing that the attachment of the pay of workmen who have just started to work after a long lay-off or who have been on small pay for a long time, has come to be a "racket" causing much hardship on account of the additional burden of sheriffs' and lawyers' fees, the management of the Scovill Manufacturing Company, the American Brass Company and the Chase Companies, are taking steps to stop such practices. It is thought that the general plan being formulated by these companies to save their employes from paying the added fee involved in attachment proceedings, contemplates advising all creditors to notify the companies of the debt instead of filing an attachment, so that the factory can arrange with the employe for a schedule of payment to be deducted in small weekly sums from wages or salaries.

✦ ✦ ✦

Standards Set for Mineral Screens

SIMPLIFIED practice recommendation R147-33 covering wire diameters for mineral aggregate production screens, is now available in printed form, according to an announcement by the division of simplified practice of the Bureau of Standards.

The recommendation, which was proposed and formulated by members of the industry, provides for the width of clear opening, and the diameter, in inches, of light, standard light, standard heavy and heavy wire used for screens in production of mineral aggregates. This simplification program will effect a reduction of approximately 75 per cent in the number of wire diameters formerly used.

Copies of this recommendation may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents each.

Canadian Wire Fencing Sales In 1932

FACTORY sales of wire fencing in Canada during 1932 amounted to 20,059,091 pounds, valued at $927,917 as compared with 35,928,158 pounds, valued at $1,702,771 in 1931. Eight factories made wire fencing in 1932; of these five were in Ontario, two in Quebec and one in New Brunswick.

Production of Wire Fencing in Canada, 1924-1932

Years.	Quantity made, Pounds.
1924	54,509,214
1925	60,084,333
1926	56,882,669
1927	47,342,274
1928	55,242,025
1929	59,152,324
1930	54,906,745
1931	34,370,689
1932—	
Farm fence 15,573,340	
Lawn fence 1,361,825	
Chain link fabric 2,548,580	
	19,483,745

Imports Into Canada and Exports of Wire Fencing, 1932

IMPORTS—	
Barbed fencing, coated or not 5,560,900 pounds	$139,235
Woven or welded wire fencing of iron or steel, from wire not more than .144 inch and not less than .080 inch in diameter, with tolerance not to exceed .004 inch; wire fencing of iron or steel, coated or not, n.o.p.	5,940
Woven netting, of iron or steel, coated, made from wire of 17 gauge or heavier, when for use exclusively on fur farms	10,979
Woven or welded wire fencing of iron or steel, coated or not, n.o.p.; wire cloth or wire netting of iron or steel, coated or not	87,054
EXPORTS—	
Woven wire fencing of iron and steel	$ 22,144

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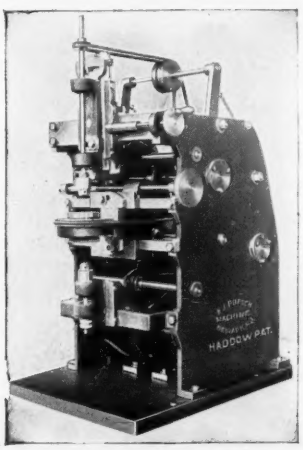

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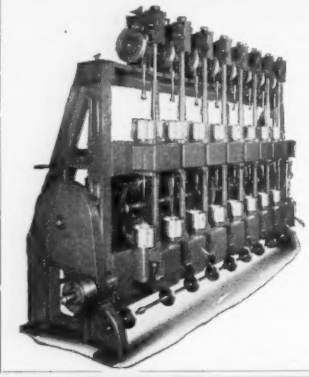

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Wire Nails And Spikes Produced In Canada In 1932

ELEVEN factories in Canada manufactured wire nails and spikes in 1932. Production from these works totaled 68,435,413 pounds, of which 67,363,738 pounds, valued at $2,239,121, were sold. In the previous year 79,613,-265 pounds were made and sales were reported at 86,175,314 pounds, worth $2,975,732.

Imports into Canada and exports of nails, 1931 and 1932, in pounds:

IMPORTS—	1931.
Wire roofing nails of all sizes and wire nails of one inch or more in length, of iron and steel, coated or not	1,199,000
Wire nails less than one inch in length and nails and brads, n.o.p. of iron and steel, coated or not	125,292
Cut nails of iron and steel, coated or not	3,400
EXPORTS—	
Nails, wire	1,612,300
Nails, brads, spikes and tacks of iron and steel, of all kinds, n.o.p.	861,900
IMPORTS—	1932.
Wire roofing nails of all sizes and wire nails of one inch or more in length, of iron and steel, coated or not	435,600
Wire nails less than one inch in length and nails and brads, n.o.p. of iron and steel, coated or not	64,658
Cut nails of iron and steel, coated or not	900
EXPORTS—	
Nails, wire	1,299,600
Nails, brads, spikes and tacks of iron and steel, of all kinds, n.o.p.	784,000

"N.O.P." means "not otherwise provided for."

(*Continued from page 336*)

manganese and 500 tons of pig iron) sixth.

✦ ✦ ✦

CARD clothing imports again rose in July to total 19,183 square feet valued at $21,318. Of this total 19,033 square feet valued at $21,189 came from the United Kingdom and the balance of 150 square feet valued at $129 from Germany.

✦ ✦ ✦

WIRE cloth and screening imports rose sharply from the June total of 8,080 square feet and amounted to 24,554 square feet. Germany supplied the larger part of this item with a total of 10,162 square feet, while 7,923 square feet originated in France, 6,049 square feet in Canada and 420 square feet in Sweden.

✦ ✦ ✦

FOURDRINIER wire imports at 50,022 square feet were below those for June and were received from Austria (23,891 square feet), Germany (15,177 square feet), Sweden (8,038 square feet) and France (2,916 square feet).

✦ ✦ ✦

RECEIPTS of galvanized wire fencing and netting fell off somewhat. Of that galvanized before weaving, 1,326,500 square feet was received, coming from the Netherlands (946,250 square feet) and from Belgium (380,250 square feet), while of that galvanized after weaving, total receipts amounted to 1,543,500 square feet, and came from the Netherlands (1,266,000 square feet), Germany (202,500 square feet) and Belgium (75,000 square feet).

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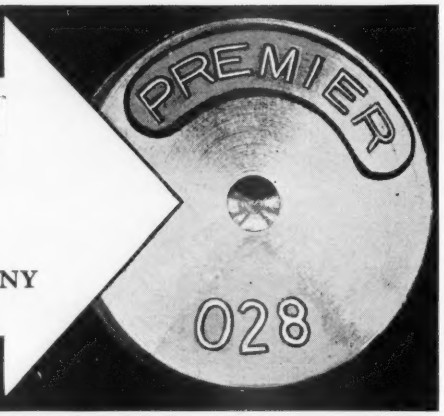

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Factories in France: Lagnieu-Cluses-Trevoux

A Review of Recent Wire Patents

(*Continued from page 343*)

No. 1,920,432, NICKEL WELDING WIRE CONTAINING TITANIUM, Patented August 1, 1933 by Norman B. Pilling, Elizabeth, N. J., and Theodore E. Kihlgren, West New Brighton, Staten Island, N. Y., assignors to the International Nickel Company, Inc., New York, N. Y., a Corporation of Delaware.

This welding wire is preferably composed of 90% refined nickel, 0.20% to 2.6% silicon, 0.20% to 0.60% titanium and more than about 0.12 to 2.0 magnesium. It is claimed that practically gas free weld results.

✦ ✦ ✦

No. 1,920,600, MACHINE FOR FINISHING BOLTS AND SCREWS, Patented August 1, 1933 by Howard D. Simkins, East Cleveland, and Oliver P. De Loe, Cleveland, Ohio, assignors to The Superior Screw & Bolt Manufacturing Company, Cleveland, Ohio.

In this machine, the finishing operations are performed simultaneously with changing the angular position of the bolts or screws, and always in a restricted extent of advancing movement of the material being operated upon.

✦ ✦ ✦

No. 1,920,903, HIGH TENSION CABLE, Patented August 1, 1933 by Karl August Haanen, Cologne-Mulheim, and Hans Meurer, Cologne, Germany, assignors to Felten & Guilleaume Carlswerk Actien-Gesellschaft, Cologne-Mulheim, Germany.

The inventor provides a multi-strand wire core with insulating, comprising impregnated, unloaded and unsized paper covering the core, this paper having a thickness reduced at least 15% from its original thickness by compression and having a density above 0.9 grams per cubic centimetre in its unimpregnated state. The object of the invention is to reduce resistance to puncturing of the insulation.

✦ ✦ ✦

No. 1,920,962, STRAND UNWINDING APPARATUS, Patented August 8, 1933 by Harold Peter Arkema, Chicago, Illinois, assignor to Western Electric Company, Incorporated, New York, N. Y., a Corporation of New York.

A sleeve is provided for centering and maintaining a reel of supply wire in a stationary vertical position, with a plug in the sleeve for clamping the reel to the sleeve and journaling a spindle which mounts a flier-arm for directing the withdrawn wire away from the reel. In addition, a tensioning device is provided for the wire drawn through the flier-arm.

✦ ✦ ✦

No. 1,921,319, MACHINE FOR ASSEMBLING SPRINGS, Patented August 8, 1933 by William F. Murnane, Chicago, and Roland D. De Lamar, Berwyn, Ill., assignors to S. Karpen & Bros., Chicago, Ill., a Corporation of West Virginia.

Mechanism is provided for weaving preformed helical connecting wire through spring structures and includes a hollow shaft with a chuck carried at its forward end, gripper arms carried by the chuck and provided to slidably engage the helical wire passing through the chuck.

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Steel Treaters Society To Change Name

AMERICAN Metals Society will be the new name of the American Society for Steel Treating if the recent unanimous resolution of the Society's board of directors is ratified by the members.

Reasons for changing the name of the A. S. S. T. as given by the directors were:

1. The Society has long since extended its field far beyond the single aspect of steel treating;

2. Members of the Society have often called the attention of officers and directors to the fact that considerable confusion has arisen from time to time because of the implied limitations of the present name;

3. The Society's scope of activities include a great proportion of non-ferrous as well as ferrous interests, with the result that any name referring only to iron and steel would be unsuitable;

4. The name "American Metals Society" is in harmony with the Society's purposes: To promote the arts and sciences connected with the manufacture, treatment and uses of metals.

The next step following the unanimous action of the directors, according to W. H. Eisenman, secretary of the A. S. S. T., is referring the resolution to the Society's Constitution and By-Laws Committee at the forthcoming annual convention in Detroit, Oct. 2-6, for putting into proper phraseology as an amendment to the constitution.

This amendment will then be submitted to the entire membership by letter ballot and will become effective when ratified by a majority of the members.

Since the first move towards the change of name came from the members themselves, and since the directors unanimously approve, it is felt that the membership will bring the name "American Metals Society" into official use by about Jan. 1, 1934.

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DIES—Diamond
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver-Harris Co., Harrison, N. J.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
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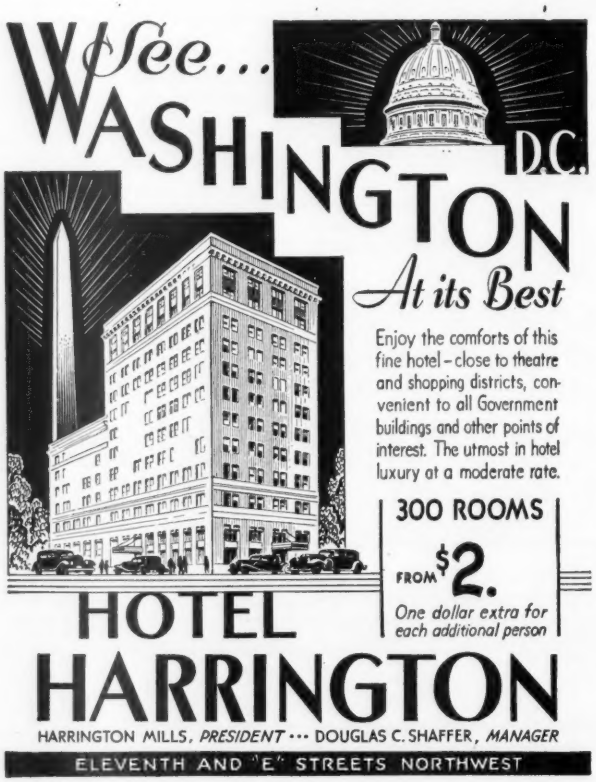
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Lewis F'dry & Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering

Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining

Farrel-Birmingham Co., Ansonia, Conn.
John Royle & Sons, Paterson, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire

Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special

American Insulating Mach'y Co., Phila. Pa.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

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The Wire Association Annual Meeting and Exhibit

Detroit, Mich., Oct. 2-5, 1933

The Wire Association,
17 East 42nd Street,
New York, N. Y.

Please reserve ..... copies of the official proceedings of the Annual Meeting and Exhibit at Buffalo, N. Y., October 2-5, at $2.50 each, payable after delivery.

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BUYERS' GUIDE, Continued

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
F. B. Shuster Co., New Haven, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wrapping, Spiral—For Wire and Strip
Terkelson Machine Co., Boston, Mass.

PACKING—Metallic Fibre
Hudson Wire Co., Ossining, N. Y.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Encasing
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REELS AND SPOOLS—All Kinds
Avoca Mfg. Co., Avoca, N. Y.
R. B. Hayward Co., Chicago, Ill.
Hubbard Spool Co., Chicago, Ill.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
R. B. Hayward Co., Chicago, Ill.
Watson Machine Co., Paterson, N. J.

ROLLING MILLS—See Machinery—Rolling Mill

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
United Eng. & Fdry. Co., Pittsburgh, Pa.

SOAPS—Wire Drawing
Drakenfeld & Co., B. F., New York, N. Y.
R. H. Miller Co., Homer, N. Y.
Robertson Co., J. T., Inc., Syracuse, N. Y.

STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VULCANIZERS
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Enameled For Coils
Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Manufacturers
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Keystone Steel & Wire Co., Peoria, Ill.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

Statement of ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of Wire & Wire Products published monthly at Washington, N. J., for October 1, 1933.

State of New York, County of New York, ss.: Before me, a Notary Public in and for the State and county aforesaid, personally appeared R. S. Spengel, who, having been duly sworn according to law, deposes and says that she is the Secretary-Treasurer of Wire & Wire Products and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Quinn-Brown Publishing Corporation, 17 East 42nd St., N. Y. City; editor, Richard E. Brown, 17 East 42nd St., N. Y. City; managing editor, none; business manager, Richard E. Brown, 17 East 42nd St., N. Y. City.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Quinn-Brown Publishing Corporation, 17 East 42nd St., New York City, Jennie R. Baker, Hammonton, N. J., and Leta B. Brown, of 17 East 42nd St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has interest direct or indirect in the said stock, bonds, or other securities than as so stated by her.

R. S. SPENGEL
(Secretary-Treasurer)

Sworn to and subscribed before me this 21st day of September, 1933.

(SEAL) CHARLOTTE FRANKL,
NOTARY PUBLIC Bronx County No. 82
N. Y. Co. Clks. No. 559, Reg. No. 5 F 335
Certificate filed in Westchester County
Commission expires March 30, 1935

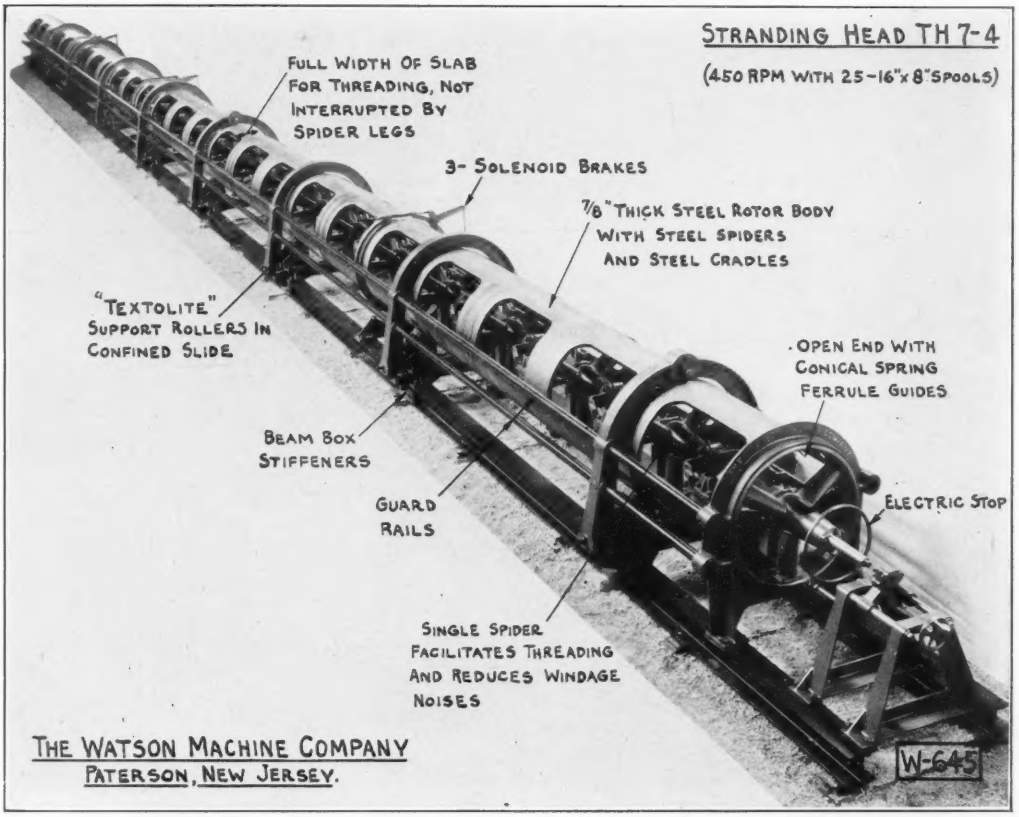
THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ENGINEERS - FOUNDERS - MACHINISTS

Tubular High Speed (All Steel Rotor) Stranders


STRANDING HEAD TH 7-4
(450 RPM WITH 25-16"x 8" SPOOLS)
FULL WIDTH OF SLAB FOR THREADING, NOT INTERRUPTED BY SPIDER LEGS
3- SOLENOID BRAKES
7/8" THICK STEEL ROTOR BODY WITH STEEL SPIDERS AND STEEL CRADLES
"TEXTOLITE" SUPPORT ROLLERS IN CONFINED SLIDE
OPEN END WITH CONICAL SPRING FERRULE GUIDES
BEAM BOX STIFFENERS
GUARD RAILS
ELECTRIC STOP
SINGLE SPIDER FACILITATES THREADING AND REDUCES WINDAGE NOISES
THE WATSON MACHINE COMPANY
PATERSON, NEW JERSEY.
W-645

These machines are built standard by us in spool sizes of 25, 50, 100, 250 and 500 pounds; in 7, 12, 19 and 25-spool rotors.

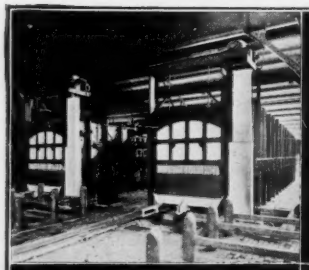
Balanced Steel Rotor Body, with Steel Cradles and Spiders, Improved Threading and Guide Arrangements, with Textolite Support Rollers, are some of the main features.

We solicit your inquiries.

ELECTRICAL WIRE AND CABLE
WIRE ROPE and CORDAGE MACHINERY

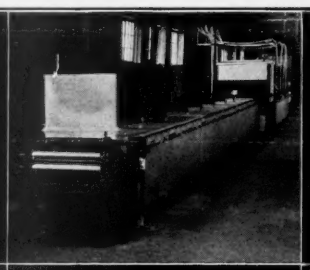
11 More Electric and Fuel Fired Furnaces -- Built Since the Depression

These and dozens of other furnaces, including several interesting furnaces for annealing steel and non-ferrous wire, have been built by our engineers during the past few months. See our exhibit at the National Metal Exposition---Space 72.



Annealing 47-ft. Tubing

Steel tubing 47 ft. long is uniformly and economically annealed in the two car-type furnaces shown at left. These furnaces are similar to the battery of seven car-bottom furnaces we built two years ago.

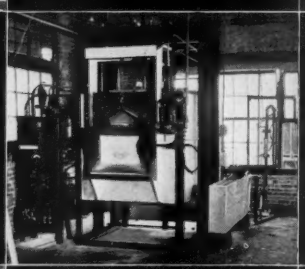


Bright Annealing Steel Strip

Cold rolled steel strip up to 24" wide is bright annealed in the continuous electric furnace shown at left—one of our new developments in controlled atmosphere furnaces.

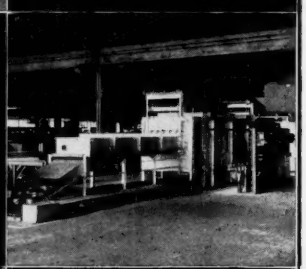
Copper Brazing Furnaces

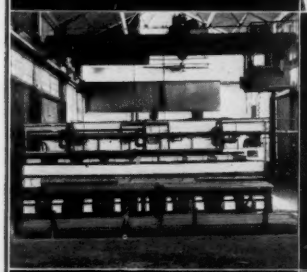
Metal parts are joined neater, cheaper and stronger in this furnace. We build these furnaces in continuous, semi-continuous and batch types. Get our leaflet describing this process.



Bright Annealing Copper Tubing

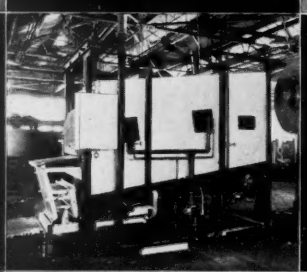
Copper tubing in coils up to 30" in diameter and in lengths up to 35' is bright annealed continuously in this new controlled atmosphere furnace;—the tubing comes out bright, clean and dry.





Continuous Pipe Annealing Furnaces

The illustration at left shows charging end of a continuous pusher-type gas fired furnace, designed and built by our Fuel Division for annealing pipe up to 23 ft. in length.

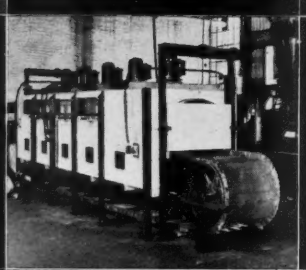


Continuous Forging Furnaces

This pusher type furnace heats and delivers slugs—one at a time—at just the right temperature, height and speed for the operator. This is the 24th furnace we have built for this concern.

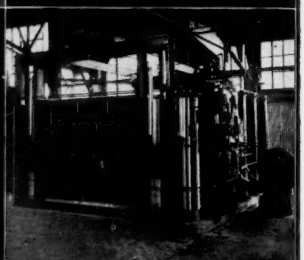
Belt Conveyor Furnaces

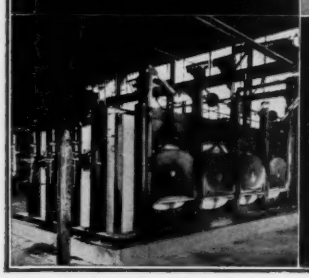
This continuous furnace—just completed—is the fifth belt conveyor type furnace we built for this company.—Get our bulletin showing these furnaces—ask for bulletin No. 4-30.



Heating Stainless Steel Billets

Oil fired hearth type furnace heating stainless steel billets in a mid-west plant, produces an atmosphere ideally suited for this work—an exact duplicate of a furnace we built for them about a year ago.





Heats Billets For Rolling

This four door, oil-fired furnace heats stainless steel ingots and billets, prior to rolling, in a prominent eastern plant. A similar six-door furnace was also built for this concern.

Enameling Furnaces

Refrigerator and other parts are enameled in this batch type electric furnace. We also build enameling furnaces in semi-continuous and continuous types—electric or fuel fired.

THE ELECTRIC FURNACE CO.

FUEL FIRED FURNACES

SALEM, OHIO.

ELECTRIC FURNACES